DISCOVERY

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DISCOVERY

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Notes of the Month.

The well deserved promotion of the Rt. Hon. W. G. A. Ormsby-Gore in the ranks of the Government has caused a change in the Office of Works which archæologists cannot but view with regret. As First Commissioner of Works, Mr. Ormsby-Gore has taken so active a part in the care of our ancient monuments, that he has not only given encouragement to his staff, but also has strongly stimulated public interest, both local and general, in the preservation of these priceless relics of past history. Only shortly before this change in office was announced, there appeared the second volume of the popular guides to the ancient monuments of England for which Mr. Ormsby-Gore himself is responsible; and at the same time the writing of the third volume was approaching completion. As a further instance of his activity, his efforts for the preservation of the character of Avebury unspoiled will be fresh in the memory of everyone.

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It is to be excpected that, as Colonial Secretary, Mr. Ormsby-Gore will find a larger scope for his talents and experience. No previous holder of this office has had so close a personal acquaintance with the problems of administration in our dependencies. As Under-Secretary in a previous administration he visited all the more important parts of the Empire, and then gained an intimate knowledge of the conditions to be faced in each. Not the least of his qualifications, perhaps, is the ready appreciation he has shown of the value of scientific research in its bearing upon the multifarious questions, political, social, and economic, with which the colonial administration has to deal.

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The question of introducing into a country animals not naturally native to it has led in most instances to disaster, or at least to developments of dubious advantage. The progress of the rabbit in Australia is a classical instance of calamity; and the introduction of the American grey squirrel and musk-rat into England has provided this country with pests of minor virulence. It is difficult to see, however, how the hatching of a stork in Great Britain—the first for some 600 years, if the record of an Edinburgh stork's nest in the 14th century is trustworthy—is going to do any harm. It should be noted first that the stork's family was not introduced, only the egg, which was put into a heron's nest for hatching; and second, that the stork is not a permanent resident in the country where it nests. Moreover the stork is an honoured visitor in those countries of Northern Europe where it rears its family; and the genial legend of its relation to the human birth-rate argues an interest at least tolerant. The project of hatching an East Prussian stork in England has no connection, however, with our falling birth-rate; it is simply for the purpose of studying the bird's migration-route to Africa, and to see whether the ringed young bird would return to the home of its birth or to the dwelling of its ancestors. The final answer must await the Spring of 1937.

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Mme. Irène Joliot-Curie, who, with her husband, has discovered a new radioactive element in aluminium, spoke of their researches to members of the Medical Association of the International Clinic, at Wigmore Hall, London, last month. Lord Lytton, who presided, congratulated Mme. Joliot-Curie on her appointment as Under Secretary for Scientific Research in the new

French Socialist Government. He described the discovery of the new radioactive element as having carried a stage further the great discovery of radium by Mme. Joliot-Curie's distinguished mother. The cheapening of radium which must result from such a discovery, he added, would be far more beneficial to mankind than the cheapening of gold could have been. They had converted one of the baser metals into something much more valuable than gold. Mme. Joliot-Curie, who spoke on " The Synthesis of New Radioactive Elements," explained that by bombarding aluminium with rays comparable with X-rays, she and her husband had been able to transform a commonly occurring and inert element into a radioactive element.

* * * *

At a dinner given by the International Clinic to Mme. Joliot-Curie, Professor F. L. Hopwood, of St. Bartholomew's Hospital, remarked that her discovery was one of the most important made in five years of " explosively rapid discoveries," and it appeared that her position in the French Cabinet, though partly the result of a desire to do her honour, would entail a great deal of hard work, devoted to the far from easy task of co-ordinating scientific research throughout France. As her department was completely new she had many problems of organisation before her. In her own research she was now engaged upon biological experiments with her newly discovered radio-active bodies.

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Despite her preoccupation with external affairs, Italy has found time to observe the progress of transport speeds and to apply the knowledge gained to her own internal communications. A service of high-speed streamlined trains will run on the Naples-Rome-Bologna route this autumn. The average speed on a trial trip was 64 m.p.h. for the whole distance, while a maximum speed of 111 m.p.h. was attained. The recently-constructed tunnel under the Apennines between Prato and Bologna has removed one of the most formidable obstacles to rapid communication between the eastern and western coasts of Italy—the steep gradient and awkward curves on the old trans-Apennine line.

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It is interesting to note, in connection with the review of Dr. K. Birket-Smith's study of the Eskimo which appears on p. 230, that a prize of a gold medal and 1,000 kronen offered by the Danish Government and open to international competition for the best essay on the origin of the Eskimo has been awarded recently to Mr. Henry D. Collins, jr., of the U.S. National Museum, Washington, D.C. Mr. Collins, who himself has excavated for several seasons on Eskimo sites in Lawrence Island, Alaska, in his thesis puts forward the opposing view to that held by the distinguished Danish anthropologist, and maintains that the archæological evidence is conclusively in favour of an Alaskan origin, derivative from the earlier archaic and Punuk cultures, with a remoter origin for certain elements, which he indicates in detail, in north-eastern Asia. On the other hand, he argues that the eastern Eskimo represent a degradation in culture, which took place in the course of their migration from the west. An interesting suggestion has been put forward recently by Mr. Diamond Jenness, of the Victoria Museum, Ottawa, who some years ago made a prolonged study of the Copper Eskimo. According to his view the eastern or Caribou Eskimo are neither original nor degenerate, but represent a fusion of Eskimo and Indian cultures. Mr. Collins is now on his way to the extreme western point of Alaska in the hope of finding evidence to indicate whether migration into America took place by this route, which many think the most probable.

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To the last *Bulletin of the Imperial Institute* Sir E. O. Teale has contributed an article describing recent gold-mining developments in Tanganyika, where the industry was started twenty-five years ago. The earlier attempts to develop the fields were hampered by transport difficulties, but railways have now been extended and roads developed, whilst the Imperial Airways port at Mbeya brings the area within six days of London and a day and a half from Johannesburg. Another article gives an outline of the mineral resources of Johore. Alluvial tin ore is being mined in three different areas. In another area iron-ore is being mined, and unworked deposits are known to occur in three further regions. Gold and china-clay are being produced in small amounts, whilst wolfram has been found and prospecting for coal is being carried on.

* * * *

A correspondent, who has just reurned from abroad, sends us some interesting comments on the paragraph dealing with the Charge of the Light Brigade, which appeared in our February issue (p. 34). Some fifty years ago, when training with the volunteer artillery, he made the acquaintance of Trumpet-Major Joy, who was then in charge of the miniature rifle range in the grounds of Wellington Barracks. The trumpet-major averred that he actually sounded the call which started the famous charge ; but whether it was the " Advance " or the " Charge " still remains in doubt.

The Electrical Detection of Emotion.

Robert H. Thouless, M.A., Ph.D.

Lecturer in Psychology, Glasgow University.

Can emotion be accurately measured by scientific means? Some remarkable results have been obtained from "psycho-galvanic" experiments, as Dr. Thouless here shows, but the fundamental causes of the changes in the electrical resistance of the human skin due to emotional disturbance remain elusive.

If a current from an electric battery is passed through the human body (let us say, from the palm of one hand to its back), the skin is found to behave as a very high resistance. The amount of this resistance is astonishingly variable, not only with different persons, but with the same person at different times. A woman, for example, showing generally the usual sort of resistance of about 10,000 ohms, astonished me one morning by having a resistance of 160,000 ohms. Afterwards she told me that her sister had died the previous day.

That may have been the reason. The special interest of this skin resistance for the psychologist lies in the fact that it depends very much on the emotional state of the subject. When he is "alert" or in a state of readiness to do something, his resistance is relatively low. As his alertness decreases, his resistance rises. When he goes to sleep, his alertness is at a minimum and his resistance remains high.

Most remarkable of all is the effect of a sudden emotion. If we say or do something to the subject which causes him to experience emotional stress even of a mild kind, we find, after a pause of nearly two seconds, that the resistance drops by an amount up to about ten per cent. and then returns more slowly to its previous amount, the whole reaction taking about ten seconds. This is a sensitive method of discovering the existence of emotional responses.

Love and the Galvanometer

On one occasion a friend defied me to find out by this method which of a list of names was the name of the girl he was in love with. I attached him to the apparatus and read out the list. To only two names did he show any response. X made a deflection of 2 cms.; Y deflected the light from the galvanometer so far that it went off the scale. Afterwards he admitted that Y was the name of his love. I asked about X and he said that she had that afternoon given him two tickets to a dance to which he meant to take Y. To Z, who had been loved by him for several years until recently Y had displaced her, he showed no deflection at all.

On another occasion at a public demonstration of this effect, my subject showed an unexpected and inexplicable reaction to the word "policeman." Afterwards he told me that, on the same afternoon, he had been reported by a policeman for leaving his car outside his office.

That skin resistance should vary with emotion is not surprising. All emotions are accompanied by changes in the skin. We can recognise strong emotion by observing that the subject flushes or turns pale. Also the activity of his sweat glands is increased or inhibited. Similar skin changes which are smaller in amount may be supposed to take place in less strong emotion and, even though these cannot be seen, they may be detected by their effect on skin resistance. It seems probable that this "psycho-galvanic phenomenon" is really a method of detecting the very small changes in the blood supply to the skin or in the activity of the sweat glands which take place in slight emotion.

Simple Connections

It is a very simple matter to make the connections necessary for showing this effect. All that is necessary is that moistened electrodes should be fastened to both sides of the subject's hand, and that he should be connected in series with a 2-volt accumulator and a galvanometer. Some investigators have used the more sensitive Wheatstone bridge circuit, but this is an unnecessary complication since the change is big enough to be measured directly.

This, however, is not the only electrical change in the skin which accompanies emotion. If we connect the skin by means of non-polarisable electrodes directly to a sensitive galvanometer, we find that from the skin itself a very small current is running and that this also shows changes when the subject suffers emotional stress. It is true that any change in the subject's resistance must affect his own current as well as an external one, but this does not account for the size of the change observed. We can, moreover, send the subject's current through a very large external resistance which will make any effect of his own change of resistance on the current from his skin as small as we like. There is no need to draw a separate diagram for this circuit since it is the same as that shown in Fig. 1 except that

the battery is replaced by a megohm resistance (the subject himself acting as battery). Since the current now is very small, the galvanometer by means of which the current is detected must also be made correspondingly more sensitive by the use of the shunt shown in Fig. 1.

When this arrangement is adopted the current still changes when the subject experiences emotion. So it is clear that the electrical potential of the person's skin is changing as well as his electrical resistance.

This change in skin potential sometimes (but not always) shows a completely different shape from that of his resistance change. Instead of being simply an increase of current followed by a slow fall, it is typically a very short rise, followed by a sharp fall, then another rise and a slow fall. So the whole curve looks like a pair of waves instead of merely a single hump. (Compare Figs. 2a and 2b.)

We thus have two very sensitive methods of indicating emotion. But science is measurement, and we should like also to be able to measure emotion. To use these changes as methods of measuring emotion is, however, of doubtful value unless we know something more about the physics of them.

One of the first and most obvious difficulties is to decide under what conditions we can say that a person's emotional responses are equal. Let us suppose that one day someone's skin resistance is 10,000 ohms and he

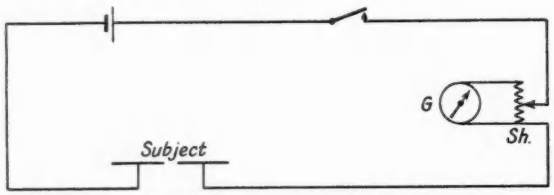


Figure 1.—Electrical connections for detecting emotion. The palm and back of the subject's hand are attached at the point marked "subject." The current is supplied from a single accumulator cell and is measured by the galvanometer G. Changes in the resistance of the subject are shown by changes in the deflection of the galvanometer.

shows a drop of 1,000 ohms when we mention Amelia to him ; the next day it is 20,000 ohms and he shows a drop of 2,000 ohms when we say "policeman." It would plainly be rash to conclude that he loves Amelia as much as he fears a policeman. It is true that his resistance has dropped 10 per cent. each time, but we have no reason for supposing that a drop of 1,000 in 10,000 indicates the same amount of emotional stress as one of 2,000 in 20,000 ohms. It seems quite likely that they are equivalent but they may not be.

The matter becomes particularly uncertain when we realise that we may not be measuring an electrical resistance but something else. Many years ago, a German physiologist suggested that what was happening was that the cells of the skin developed a back electro-motive force of polarisation when an electric current was passed through them and that it was this polarisation that changed with emotion. Such a polarisation would behave very much like a resistance and there is no simple way of distinguishing between them. If this explanation is the true one, we should be wrong in talking about the "resistance" of the skin. "Apparent resistance" would be a better term.

About thirteen years ago I set myself the task of trying to discover how much of the apparent resistance of the skin was a real electrical resistance and how much was polarisation, and which of them changed with emotion. This knowledge seemed to me to be necessary before we could make much use of the change in apparent resistance as a method of measuring emotion. I did not succeed so well as I should have liked, and, so far as I know, no one has succeeded in answering these questions completely. I found out a few other things of minor interest, but I am quite certain now that if the main question is to be answered satisfactorily, it must be by a research worker with far more knowledge of the physics of polarisation than I had.

One fact that strongly suggests that there is something in the polarisation explanation is the fact that the apparent resistance of the skin changes with the amount of current passing through it, being less as the current is increased. Also, as the German physiologist had shown, it is less with an alternating current and decreases as the rate of alternation is increased. I found, too, that the drop in apparent resistance when the subject has an emotion is less with more rapid alternating current and becomes unmeasurably small when the current alternates 4,000 times a second. This is what we should expect if the apparent resistance were really polarisation, since in the very small fraction of a second that the current is flowing in one direction, the back electro-motive force which opposes it has not time to form. It is not, however, quite conclusive. The same result would follow if the skin, the electrode, and the bodily tissues under the skin formed a condenser in which the skin played the part of the waxed paper and the electrodes and body tissues played the part of the tinfoil. An alternating current passes through a condenser more easily as its rate of alternation is increased, and the resistance of the insulator (if it is an imperfect one, as the skin certainly is) plays a smaller part in the apparent resistance with a rapidly alternating current until finally it will not be possible to detect any changes in it.

Whatever the reason for this much lower skin resist-

ance with alternating currents, it is of some practical importance. The high resistance of the skin gives us a good deal of protection against a direct current but much less against an alternating current of the same voltage. People have had severe shocks and have even been killed by alternating currents of a voltage which would have been quite safe if the current had been a direct one. Alternating currents are now commonly used in houses and the resistance of the skin to alternating current is low enough for the voltage of 200-250 volts to be able to cause a severe shock.

At the same time, the rate of alternation (50 cycles per second) is not very great, so the resistance of the skin to the current will vary with emotional conditions as well as in different persons. So it is possible that electrical connections may be handled safely by one person but not by another, and perhaps not by the same person at a different time when he is in a different emotional condition. Since we know that the skin resistance is at its lowest in a condition of emotional stress or in one of heightened alertness, it would seem that, if it is necessary to handle live electrical connections without being properly insulated, our best chance lies in preserving a passive and calm emotional state. Undoubtedly it is still safer to switch off the current at the mains.

It would be of little interest to recount all the methods by which I tried to measure separately the resistance and the polarisability of the skin. For a long time I imagined that there was some simple modification of my circuit which would enable me to do this. While otherwise occupied or during a sleepness night a dazzling idea of a new circuit to solve the problem would come into my mind. I would make a diagram of it and the next day I would connect it up, always with the same result, to find that I was measuring apparent resistance as before with no indication of how much was really resistance and how much was polarisation. It was a long time before I realised that the problem was not soluble by such methods.

My last experiment was one in which I tried to find out whether the deflections would disappear if a large direct current was passed between the electrodes at the same time as the apparent resistant changes were measured by a small alternating current whose frequency was low enough for the effect still to appear. My hope was that the direct current would produce all the time the maximum polarisation possible so that no further change in that could take place, so that any change in the alternating current must be due to resistance changes alone.

The experiment might prove to be a painful one so I had to use myself as subject. I succeeded in reducing to a pulp the patch of skin on the back of my hand under the electrode, but not in getting rid of any effects of possible changes in polarisation. Even with 40 volts applied to my skin the polarisation did not seem to have

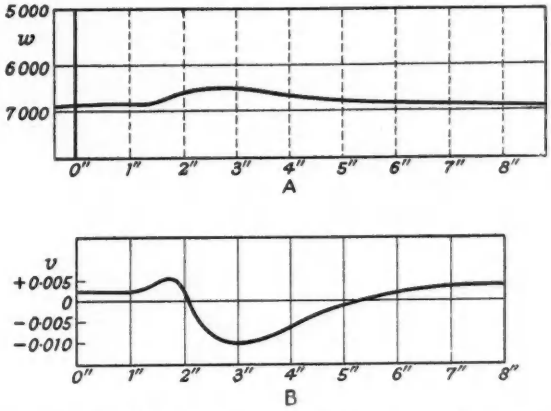


Figure 2.—Typical changes in : (A) the resistance (B) the skin E.M.F. of a person experiencing emotion at the point marked O. The diagrams read from left to right and are reproductions of photographic records of the changes which take place during 8 seconds after the emotion experienced.

increased to its maximum amount. The experiment was not, however, altogether a failure. The galvanometer deflections with emotion grew less as the direct current voltage was increased although they did not disappear even when the direct current was of 40 volts. The interesting fact of the experiment was that they grew less at about the rate which one would predict if they were changes in polarisation and not in resistance. So this experiment too pointed in the same direction.

Soon after this I became interested in other problems more directly connected with my own subject of psychology and less difficult to solve. So I said farewell to the problem of skin polarisation with my main question only half answered, but with a conviction (that I ought to have gained several years earlier) that no more complete answer could be discovered by me.

Nobody else seemed to think that the question was of any importance when its investigation seemed to me to be the one thing worth while. Now that the urgency of this impulse has gone, I am inclined to agree with them. But I got a lot of fun out of the investigation while it lasted, and that is one of the justifications of scientific research. If I am tempted to regret the time I spent on the problem and to think that I might have found out much more if I had felt impelled to plough a less unfertile field, I can comfort myself with the thought that I might have spent the same amount of time and energy in solving cross-word puzzles and accomplished nothing at all.

New Light on Ancient Assam.

By J. P. Mills, I.C.S.,

Hon. Director of Ethnography to the Government of Assam.

The reconstruction of the social history of ancient South-East Asia is slowly being achieved; and this account of the recent discovery of Mon-Khmer megalithic urns on a remote plateau in Assam is an important link in the chain of evidence. Speculation is at once aroused as to how many more monuments may be lying unsuspected in the jungle.

A unique discovery may be sensational, but to the scientist it is of little value till other discoveries are made that can be connected with it. In 1928 I was fortunate enough to find in Assam some striking monuments of an unknown culture, on which the Asiatic Society of Bengal published a paper by Dr. Hutton and myself in 1930.[1] It is only now that Mlle. Colani has enormously increased the value of my find by the discovery of precisely similar monuments in Tonkin[2] and Van der Hoop has drawn attention to existence of stone urns of the same type in Minahassa and the Celebes[3] that I venture to offer a brief description to a wider public.

In January, 1928, while I was touring in the sparsely-populated sandstone plateau which forms the Western portion of the North Cachar Hills Subdivision in Assam, some Nagas, knowing my interest in relics of the past, asked me if I would like to see some curious stones. Turning aside into the low grass jungle they showed me two recumbent, pear-shaped monoliths, hollowed out at the thick end. I knew at once that I was looking at something hitherto unknown in Assam. To my eager enquiries they replied that there were plenty more on the plateau, but I never imagined I should see what I did. At a village called Bolasan I looked down from a ridge, and there below me lay a group of no less than four hundred of these huge stone urns, some fallen, but most of them still upright. They showed above the grass like the backs of a great herd of buffaloes.

A stone "male" urn, of the long type.

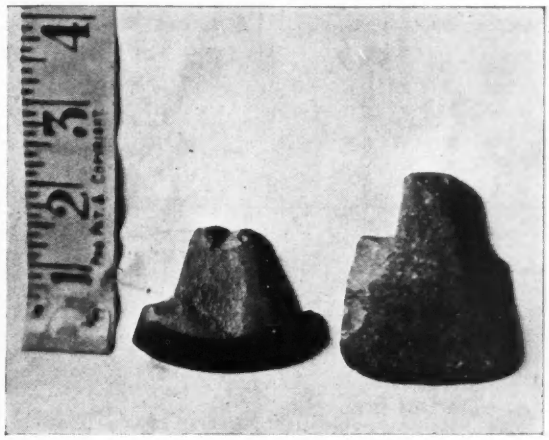
It was a sight to gladden the eyes of an archolæogist and one certainly never reported, and probably never before seen, by a white man. Visits to other groups followed, and the problem of interpretation became so important that I lost no time in asking Dr. Hutton, of his charity, to come and tackle it. This he very kindly did the following autumn, visiting the whole area with me.

The plateau has a poor soil and is badly watered, and could not now support a population large enough to carve and erect these monuments. The few Nagas and Kukis who live there have no traditions on the subject and there is nothing in their culture to suggest that they are the descendants of the urn people. We therefore only had the monoliths themselves and the objects associated with them to guide us as to who the makers were and what their purpose was.

All the monuments are essentially urns, some with shallow cavities and some so deeply hollowed out that they ring when struck. We found there were two types, male and female, the sex of the latter being indicated by suggestive incisions. The female stones have flat bases and are somewhat bucket-shaped. They are usually three to four feet in diameter. The male stones vary from almost cigar-shaped to pear-shaped, with the cavity always at the broad end. The size also varies greatly: the smallest urn we found was only eighteen inches high, while the largest were so deeply sunk in the ground that we could not measure their height, but the biggest of all has a greatest circumference of 23½ feet and a cavity at the top no less than 5½ feet deep. All the urns are of sandstone and some have naked human figures, human heads, pigs, deer, etc., incised on them. Obviously all are not of the same age and their erection

[1] MILLS and HUTTON: *Ancient Monoliths of North Cachar. J.A.S.B.* XXV, No. 1, 1929.
[2] COLANI: *Communications au Premier Congrès de Préhistorie d'Extrême Orient.* Hanoi, 1933.
[3] VAN DER HOOP: *Megalithic Remains in S. Sumatra.*

"Male" urn, of the round type.



Shouldered celts found near the urns.

must have continued over a long period. As to the date of that period there is no evidence at all.

With the urns are associated pairs of twin tanks, polished shouldered stone celts of a type very rare elsewhere in Assam, menhirs flat in front and round behind like cricket bats, and round sitting-stones. Many of the menhirs and sitting-stones have human beings, animals, and other designs carved on them, but it is possible that these are the work of Kukis or Nagas. The designs on the urns are, however, contemporary with their making, for we were able to move some of the smaller fallen ones and reveal carvings protected by contact with the ground.

The greatest puzzle was the purpose for which these hundreds of urns had been laboriously carved, transported, and set up. We eventually came to the conclusion that they had once held the ashes of the dead, and this opinion was confirmed by the finding in one of them of cremated remains, which were identified by Sir Arthur Keith as human.

As for the vanished race which has left such wonderful monuments behind, we considered it must have been akin to the Khasis and Syntengs, who inhabit adjoining territory to-day. They still burn their dead and collect their ashes in stone dolmen cysts. True they make no urns, but the hardness of the stone of their country is sufficient to account for that. Now the Khasis and Syntengs are an isolated group of the great Mon-Khmer family, and it is in another Mon-Khmer area that Mlle. Colani has discovered almost exactly similar stone urns. The relation of the two discoveries and their joint importance has recently been explained by Dr. Hutton.[4] These urns and shouldered celts, or hoes, are typical of the Mon-Khmer branch of the great linguistic family known as Austroasiatic. Languages of this family are found, as Dr. Hutton has pointed out, from the Himalayas to New Zealand, and from Madagascar to Easter Island. No other language of the ancient world had anything approaching such a wide distribution. Compared with it Latin, at the time of its widest spread, seems almost a local dialect! It is fair to infer that the wider the distribution the greater the age, and scientists may be right who think that a language of this family was talked in the streets of Mohenjo-daro and other cities still buried under the desert sand. To what heights of

A "female" urn, of the characteristic bucket shape.

[4] HUTTON: *Mon and Munda in India and Beyond. Proc. of the Nat. Instit. of Sciences of India*, Vol. 1, No. 2.

culture this race attained we have little inkling, for no great people has ever sunk so deeply into oblivion. Every vestige we can recover from the past is precious. Scattered tribes still speak their tongue, but their monuments lie unnoticed on lonely uplands or in dense jungles.

Newer Developments in Anæsthetics.

By Mary G. Cardwell, M.D.

Medical science is ever experimenting to improve the art and practice of anæsthesia, and during the last few years great advances have been made in the effort to find, or to manufacture, the perfect anæsthetic.

So long as man is susceptible to the feelings of pain so long will he experience the need of anæsthetics to render him insensible to suffering whilst surgical art operates to relieve him from the source of his pain.

The ideal drug for this purpose is one which will provide the maximum of safety during anæsthesia, with the minimum of bodily and nervous disturbance either at the time of administration or afterwards, together with the speedy production of unconsciousness and quick recovery rate.

With some patients, the ill effect to be feared from an anæsthetic is the likelihood of collapsing from sheer dread at the thought of becoming unconscious and experiencing the unknown, and this emotional stress is a potent factor to be reckoned with in estimating the dangers of an operation. To minimise this danger modern anæsthesia has adopted various ways of producing unconsciousness.

In 1928 a drug was manufactured called Avertin, and it was found that this could be given by the bowel in the form of a rectal enema before the patient entered the operating theatre. In the case of very nervous patients no mention is made of the anæsthetic or day of operation, and he is simply aware of having his bowels emptied by an enema for a day or two before the operation. One morning the usual procedure is adopted but he finds himself pleasantly sleepy and after a period of complete unconsciousness awakens to find that he has had his operation and is safely back in bed, having escaped the horrors of anticipation. The drug is calculated according to the body weight of the child or adult and is given dissolved in olive oil by way of the rectum, and the quantity of solution being small he does not tend to evacuate it as happens with the usual bowel enema.

Another modern method of lessening nervous apprehension is to give the patient a sleeping draught the night before, and then in the morning, sometime before the operation, he is given a capsule of Nembutal or Pronocton. These may produce a sufficiently deep degree of unconsciousness for the operation, and if not, it is easy to deepen the narcosis by giving a little ether or other inhalation anaesthetic on a face mask.

Advances in the art of modern surgery have made the speed of operating much more rapid, and therefore it has been possible to use anæsthetics with a very quick induction rate and an equally rapid recovery period. The two best known are probably Sodium Evipan and Vinethene.

Sodium Evipan is a derivative of barbituric acid, and came into use about 1932. It can be given in tablet form but is most usually administered intravenously. It is especially useful for short operations such as are performed on hospital out-patients, and for midwifery when the child is just being born. It produces a rapid and deep, but short, anæsthesia and has a quick period of recovery which is often followed by a short and natural sleep. Sodium Evipan is a white powder and is used dissolved in distilled water. The solution is prepared fresh for each operation and is injected slowly into a vein of the arm. The patient is instructed to count aloud, and usually when fifteen is reached the counting is succeeded by several deep yawns after which the patient is completely unconscious. The disadvantage of the drug is the quick recovery rate which renders it unsuitable for lengthy operations.

Vinethene is a liquid compound of ether, and is given either from a face mask through a drop bottle or mixed with CO_2 and delivered from a gas apparatus. Unconsciousness usually supervenes in about four minutes and recovery is similarly rapid. So far it has not appeared to produce the usual irritative effects of ether on the respiratory tract, but undesirable effects on the liver have been recorded where the patient was in a very undernourished condition.

Efficiency *v.* Cost.

Another inhalation anaesthetic characterised by the rapid production of deep anæsthesia and a quick recovery rate is Cyclopropane. It has been used since 1929, and is a colourless, sweet smelling, inflammable gas used in a closed cylinder apparatus in conjunction with oxygen and CO_2. It has been found to induce unconsciousness without any increase in, or irregularity of, the respiration rate, and without any irritation of the throat or lungs, and is therefore valuable as an anæsthetic for chest and throat operations. Its chief disadvantage is its cost and the need to use it from rather a

bulky apparatus. But probably these factors may be obviated as science progresses along the lines of further research.

Of late, much attention has been directed to the alleviation of pain in childbirth by the use of anæsthetics and much money and research have been devoted by the Birthday Trust Fund towards this end. Various methods of anæsthetising the woman in labour have been tried out at different hospitals all over the country, and the investigation is still proceeding. Probably the biggest advance so far in this particular aspect of anæsthesia, and resulting from the use of these funds (at least in Britain), has been the employment of what is known as Minitt's Gas-Air apparatus.

This is a combination of cylinders and specially constructed valves by which nitrous oxide and air are used in combination and delivered by the medium of a closed circuit. Nitrous oxide is in most respects an ideal anæsthetic, especially from the point of safety, and the purpose of this apparatus is to deliver the gas at a pressure just sufficient to abolish sensitiveness to pain. This having been found, the gas is fixed by the valve mechanism so that it is inhaled at this pressure. A tube leads from the cylinder to the face mask and the patient is instructed to apply the latter to her face and keep her finger on an automatic valve. If she becomes too deeply unconscious, the valve becomes released and cuts off the gas, leaving only air to enter the mask.

The advantages of the Minitt apparatus are its safety, and freedom from harmful effects on the body cells, and the fact that its use does not interfere with the muscular contractions necessary for delivery. At the present time its employment in general practice is unlikely as the apparatus is both cumbersome and costly.

It is very likely that the immediate future will see a notable advance in the knowledge and practice of general anæsthesia, but the public should be prepared to wait patiently for developments and not clamour for the unwise and premature use of some of the newest anæsthetics, since sufficient time has not yet elapsed to permit scientists to say that the last word in this regard has been spoken.

Empire Summer School.

This year the Royal Empire Society is holding its Empire Summer School (July 24th—31st) at the University of Bristol, which is providing accommodation both for meetings and for residence. A distinguished list of speakers bodes well for a remarkable variety of talks on empire subjects; and the School offers a unique occasion for visiting a city which is second to London alone in its combination of ancient fame and modern activity.

New Maps of Scotland.

In good time for the holiday season two new Ordnance Survey Tourist maps have made their appearance. These cover two famous and beautiful regions of Scotland—the Cairngorms and Oban District—and, being on the scale of one inch to a mile, are admirably suited to walkers. The areas covered by these maps are considerably larger than those of previous editions (e.g. the Oban map extends to Inveraray), the system of layer-colouring and hill-shading has been improved, and motorable roads are shown in three categories. The covering grid is now divided into 5,000-yard squares. The price of each of these maps is: paper, 2*s.* (flat) or 2*s.* 3*d.* (folded); mounted and folded, 3*s.*; mounted in sections and folded, 4*s.* 6*d.* The conventional signs included are simple and almost self-explanatory. "Private" roads are shown uncoloured; but walkers would be grateful for some differentiation, on "tourist" maps, between accessible private roads and those guarded by savage gamekeepers, a notable feature of the Cairngorm region, especially in the stalking season. Few of us wish to spoil the other man's sport, but we do like to be assured of a reasonable amount of "access to mountains" free from the risk of wordy disputes.

Progress in the Sciences.

Under the general rubric *The University Series: Highlights of Modern Knowledge*, Messrs. Chapman & Hall are publishing in England, for the University Society of New York, a series of a dozen volumes at 4*s.* 6*d.* each, dealing briefly and clearly with the present state of knowledge in as many departments of science: Astronomy, Geology, Botany, Zoology, Palæontology, Biology, Genetics, Anthropology both Historical and Physical, Protozoology, Physics, and Relativity. The writers are eminent American authorities, for the most part holding professorial appointments in Universities of the highest standing, among whom readers of DISCOVERY will recognise Dr. Stuart Gager, Director of the Brooklyn Botanic Garden. The books are not intended to be text-books; their aim is to indicate the main points of knowledge as it stands to-day, laying special stress on matters of modern importance. In this they succeed, according to the best test that we can apply. Having read through the volume dealing with the subject of which we knew least, we came away with (we hope) a clear idea of the essentials of the subject and the aims at which further research is directed. These volumes are to be highly recommended to readers who would extend their knowledge beyond their immediate "shop".

The Crimea: A New Study.

By R. B. Mowat

Professor of History in the University of Bristol

No one is better qualified than Professor Temperley to provide a dispassionate study of Near Eastern events in the 19th century; and the volume here reviewed is the welcome forerunner of his long-awaited series on England and the Near East.

Sir Robert Morier, a famous British ambassador, said that the Crimean War was the only wholly unnecessary war in modern history. This generalisation was applied to history down to about 1880. Within this limit, perhaps most people will agree with Morier's statement, though he seems to have forgotten the Anglo-American War of 1812-14, which neither side wanted to fight. The Crimean Warseems to have been of this kind too. Neither the British nor the Russian Government started the war with any ardour; and Professor Temperley has found evidence to indicate that even Napoleon III, usually regarded by historians as the chief promoter of the war, did not force it on. It is a curious spectacle: three rather lethargic governments involving themselves in a terrible war with each other, and none quite knowing how it happened. The Russian official "Diplomatic Study," explaining how the war broke out, was not published until years after the war was over.

H. W. V. Temperley.

The Crimean War, as treated by Professor Temperley, is only an episode, though a big one, in the general history of *England and the Near East*,[1] the title to be applied to the whole study when completed. The present book, called *The Crimea*, is Volume I. Professor Temperley writes:

> My aim is to narrate the history of England's relations with the Near East from the death of Canning until the day when Disraeli brought back "peace with honour" from Berlin. The period begins with the British fleet's destruction of Turkish sea-power at Navarino and ends with its protection of the Turkish capital against Russia. The aim, however, is not a study of diplomatic or naval history, but a general narrative in which these special features are found side by side with a study of Oriental institutions and of Balkan nationalities.

Thus the complete work will cover fifty-one years of the Near East, 1827-1878.

The real question of the period, the Eastern Question, as it used to be called, was whether a spark of life remained in the old Turkish Empire. "Could the 'sick man,' who lay behind the walls of Stamboul, recover his strength?" Recovery would depend upon three factors: the ability of the Turks to reform; the willingness of their Christian subjects to acquiesce in the process; and the readiness of the Great Powers to help or hinder this evolution. In effect, no substantial amount of recovery ever took place. Yet the spark of life was there, and Turkey has at last reformed itself and become a strong, up-to-date state, by discarding all its Christian provinces and sweeping away the Sultanate, Seraglio, and Caliphate.

This study of the Crimea begins with the reign of Mahmoud II (1808-1839) though he died nearly fifteen years before the Crimean War began. This Sultan is justly given credit as a reformer. His mother was a French creole whom Barbary pirates had brought to the Seraglio at Constantinople. He began—and continued—his reign with great energy, starting by completely subduing the Kurds, the "greatest" of whom, Mohammed the Blind, used to cut off the lips of all trespassers on his domains, whether cattle or men, and had recently butchered seven hundred persons. This fact is extracted from the Foreign Office archives, Lord Ponsonby's reports. Mahmoud II himself was not behindhand in butchery. When the Greek revolt began in 1821, he let loose his hordes of troops with complete ruthlessness, with the result that hundreds of pairs of ears, trophies of the war in the Morea, were nailed to the Seraglio gate. The numerous disorderly corps of Janizzaries was slaughtered by the Sultan's orders in 1826, "one of the great massacres of history," as Professor Temperley calls it; the effect was beneficial

[1] Harold Temperley, *England and the Near East: The Crimea* (Longmans, Green. 25s.).

to the Turkish Empire. The reforming Sultan issued a reasoned defence of this massacre in book-form and established the first press in Turkey in order to print it.

Mahmoud's biggest effort—in which he failed—was against his over-mighty subject, Mehemet Ali. This powerful man was Pasha of Egypt, and at various times added to his lordship Crete, Palestine, and Syria. He fought the Sultan Mahmoud twice, in 1832 and 1839, and nearly broke up the Turkish Empire; and the Powers of Europe had to exert themselves to save Turkey from him. Russia under Nicholas I was just as anxious to preserve Turkey-in-Europe as was the British Government. The Daschkov Memorandum, accepted by the Tsar in 1829, took the view that to fling the Turks out of Europe into Asia would renovate their strength and would cause grave difficulties to Russia in the Caucasus. So when Mehemet Ali's army threatened to advance on Constantinople in 1832-33, the Tsar made the defensive alliance of Unkiar Skelessi with Sultan Mahmoud. This treaty supported the *status quo* in Turkey and made the Tsar its defender; Palmerston feared that it might almost convert Turkey into a Russian protectorate. Nicholas, however, used his power with exemplary moderation. When Sultan Mahmoud again came to blows with Mehemet Ali in 1839, Nicholas did not claim to act alone but joined in the Concert of Europe to settle the trouble amicably along with England, and with France too, if France would have consented to act with him. In regard to the military operations of 1839-40, and particularly the exploits of Captain Napier off and on the Syrian coast, Professor Temperley gives much new information, taken from manuscript sources and also from personal observation of the ground and scene of action. The revolt in the Lebanon against Mehemet Ali is described, and much highly interesting detail is given about the Druses and Maronites. This part of the book is as graphic as Kinglake's *Eothen*. The result of the operations of 1840 was that Mehemet Ali had to give up Syria and Palestine and restrict himself to Egypt, where his family is still ruling.

Russia Misunderstood

During the crisis of 1840 the Russian Government, represented by the eminent ambassador Brunnow at London, acted loyally with the British Government, although Palmerston at the Foreign Office and Ponsonby, ambassador at Constantinople, were both distinctly anti-Russian. When the Mehemet Ali trouble was over, Nicholas set himself to solve the Eastern Question—that is, to arrange a scheme for meeting the break-up of Turkey, the death of the "sick man," which he now thought inevitable—by agreement with England. On three separate occasions he made deliberate and persevering efforts to do so: in 1844, 1849 and 1853. He knew that the British Government did not like to commit itself in advance against a contingency that might not occur at all or might not occur for a long time. He was very accommodating, however, and did not ask for a formal treaty; he only wanted the word of an English gentleman in which he had implicit faith—a verbal assurance from Lord Aberdeen or Palmerston or Peel would have satisfied him. The famous conversations of the Tsar with Hamilton-Seymour in 1853 about the "sick man" were not a trap. Professor Temperley supplies evidence to prove that Nicholas never wanted to possess Constantinople, but only Moldavia and Wallachia; that Crete and some other Turkish islands were to fall to France; that Austria was to have the Adriatic coast and Archipelago; England was to have Egypt and Cyprus; Serbia, Bulgaria and Montenegro, presumably, were to be independent. Hamilton-Seymour, British ambassador at St. Petersburg, reported the Tsar's conversations unfavourably to the Foreign Office, and the Tsar's proposals were never given a fair consideration in London or Paris. If the British and French Governments, after reflection, had decided against the proposals, properly understood, there still need have been no Crimean War. The Tsar was not going to attack Turkey, if his proposals were rejected by the other two Powers; the *status quo* would have endured until the "sick man" (or rather the "bear," which was the expression that Nicholas actually used) should really die. "The efforts of Nicholas to arrive at a good understanding with England were inspired by a sincere and even noble emotion." This is Professor Temperley's verdict.

Drifting into War

Stratford Canning (or Lord Stratford de Redcliffe as he became) has an enhanced reputation as a result of the evidence contained in this book. During the critical month, October, 1853, he lost influence with the public owing to his insistence upon peaceful steps. His order for the British fleet to enter the Dardanelles, along with the French fleet, was due to pressure from the British Cabinet. In regard to this summons to the fleet Lord Stratford had a certain amount of discretionary power; with regard to its being sent, eight weeks later, into the Black Sea he had none. He was acting under definite orders from the Secretary of State.

Readers should note carefully the documentary evidence supplied throughout the book; but besides this, a summary of the whole question of responsibility for the Crimean War is given in Appendix V. Along with Lord Stratford, Napoleon III comes with an improved reputation out of the discussion; that is to say,

he is exonerated from the brilliant Kinglake's charges of having forced on the war. He is shown to have desired peace and to have given instructions to his diplomatists in this sense. In public, however, he took some very dangerous steps, in order to please certain sections of French opinion. As regards the British Cabinet Professor Temperley comes to the conclusion that the old charge against it is correct: it "drifted" into war. The Tsar's chief measure of responsibility is in giving orders to his army to occupy the Principalities of Moldavia and Wallachia, a step which he did not mean to lead to war, but which he took in order to put pressure into his policy at London, Paris and Constantinople.

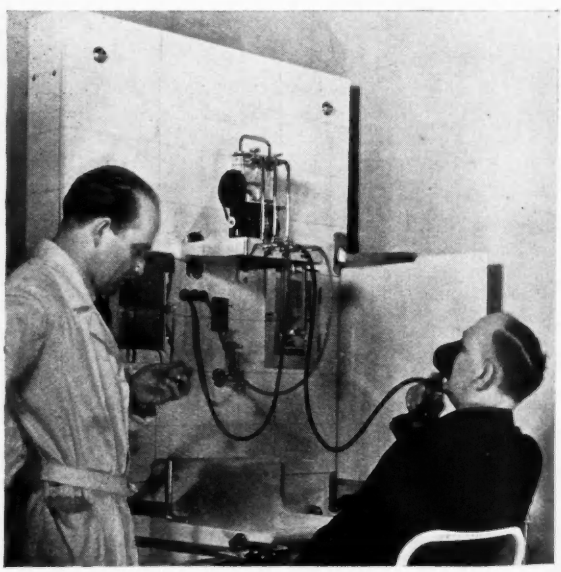
Professor Temperley's book stops with January, 1854. He will find plenty of scope for more revisions of historical judgments in his investigation of the next twenty-five years.

Vaporisation of Medicines

TO-DAY various drugs can be inhaled after having been transformed into vapour by an electric sprayer. The idea of introducing medicines into the body without the person concerned having to swallow them or by injection, has been made possible by this handy and simple apparatus. By means of an electric compressor the "Atmos" inhalation apparatus makes it possible to transform various liquid medicines, especially drugs for the treatment of asthma and bronchitis, into a vapour which can be just as easily and painlessly inhaled as air or cigarette smoke. The very fine dispersion into which the medicine is dissolved in air causes a very quick absorption, and consequently the desired effect is almost immediate. With the aid of this inhalation apparatus, it is claimed that an attack of asthma can be overcome instantly. The dry and vaporised medicines reach the seat of trouble directly, as far as illnesses of the chest are concerned, and therefore the inhalation is likely to be a much more effective means of healing than methods formerly used. Generally the patient prefers the inhalation method to swallowing unpleasant drugs, or to suffering injection punctures.

The new method of inhalation is therefore to be recommended, especially in cases of illness of the respiratory organs, and a large variety of different medicines are at the disposal of doctors to deal efficiently with each individual case.

The medicament is converted by the nebuliser into a very finely dispersed spray. Here the spray is directed against a mirror; its dryness is shown by the fact that the glass does not dim.



Modern inhalation establishment fitted with an "Atmos" inhalator. The patient's chair is adjustable to the position most convenient for the inhalation appropriate to the treatment required.

Butterfly Immunity in Malaya.

By L. Richmond Wheeler.

In a country possessing so plentiful and varied a butterfly fauna as does Malaya, observation of these insects can be made very thoroughly. Mr. Wheeler proves conclusively that butterflies are rarely attacked when on the wing; their brilliant upper wing colouring can therefore hardly be regarded as a protective development.

I HAVE lived in Malaya for fourteen years and have travelled frequently over much of the country, on duty and pleasure. Natural history, especially that of birds, has always been an interest here and in other parts of the world. I began to give special attention to Malayan butterflies in the beginning of 1934 and have collected and studied them closely since then.

At the beginning of this period I accepted the views held by neo-Darwinians, expressed, for instance, in the *Encyclopaedia Britannica* 14th edition (art. *Mimicry*), that the colours of butterflies have been produced under the stress of the struggle for survival. And as reference is usually made to the *upper* wing colours in Darwinian books and articles dealing with mimicry, warning coloration, and so on, I saw no reason to challenge the underlying assumption that during flight, the only time usually when these upper wing colours are displayed, butterflies are exposed to attack by the only animals that can then seriously harass them, that is, birds. The importance of this matter for *butterfly* mimicry is admitted by critics and exponents of what is at present the orthodox scientific view.[1]

Arthur Wheeler, aged 3½, who knows how to net butterflies, and the Author.

But critical study of the various expositions of the evolution hypothesis and the fact that I happened to be living in a country rich in butterflies led me to combine outdoor observation of these insects, which are so often discussed in connection with evolution, with further analytical investigation.

It soon appeared evident that there was room for further observation on attacks by birds upon butterflies. Sir Guy Marshall, who upholds the view that birds are a serious menace to flying butterflies, has written that "heaps more evidence" is needed, for "not one of those excellent observers, Wallace, Bates, F. Müller, or Belt, has given us a single record of attack in which either bird or butterfly was identified."[2] And subsequent records, it seems to me, have not disclosed such regular assaults as the theory of mimicry demands. Malaya has over seven hundred species of birds and over eight hundred species of butterflies and is a country from which little positive evidence has so far been forthcoming, as Carpenter and Ford admit[3]; while the authors of the best recent book on Malayan butterflies say that "it is a rare sight to see a bird in pursuit of Lepidoptera,"[4] let alone butterflies only.

So I began to look out for such attacks; and it seems worthy of record that I started with the idea that they should prove to be at least not infrequent, though I could not recollect any definite instances during the time when my interest lay with birds.

Quite early two cases occurred which I thought were captures of butterflies during flight by birds. On February 7th, 1934, I saw, or thought I saw, a Magpie Robin (*Copsychus saularis musicus*) take a *Catopsilia* in

[1] *e.g.*, CARPENTER & FORD: *Mimicry* (Methuen, 1933), p. 67.

[2] *Trans. R. Ent. Socy.*, 1929; p. 383.

[3] *Op. cit.*; p. 68.

[4] CORBET & PENDLEBURY; *Butterflies of the Malay Peninsula*, 1934.

my garden at Taipeng, both being on the wing. And within a few days I thought I observed a similar occurrence, though with a different bird, at the edge of the jungle near the Taipeng Swimming Club. Then I frequently observed birds and butterflies together but noted no further cases of attack, or anything approaching attack, for over a year. On February 24th, 1935, however, while motoring in Kedah, I saw a Yellow-vented Bulbul (*Pycnonotus goiaver analis*) hawking after a small, dark insect, which was probably a *Mycalesis* but might have been a moth. Both were on the wing, and I could not observe how the affair terminated.

From sundry accounts I have received of occasional attacks by these bulbuls upon flying butterflies it is is probable that the insect escaped; this, however, is immaterial. What is important is that the first two cases, which I accepted at the time as positive ones owing to preconceived ideas, now appear highly doubtful after eighteen months' intensive study of books, butterflies, and other people's experiences. In neither case did I observe the butterfly in the bird's mouth; and it seems quite unlikely that the moderate sized birds should have swallowed a fairly big butterfly like

The Reservoir, Bukit Mertajam, Straits Settlements, surrounded by hills and tropical jungle; a good spot for butterflies—and birds.

Catopsilia in one mouthful as a swallow does a gnat or flying termite.

Against these three very dubious instances stands a mass of negative evidence which cannot be treated as negligible except by a very prejudiced person. On most days during the period of investigation I have seen butterflies flying or feeding in gardens and areas where birds were abundant; very often they were flying about in the closest proximity. On about a hundred occasions, in or near the jungle, on hill stations, by waterfalls, and other favoured haunts of butterflies, I have collected and observed these insects during the most favourable hours of the day, mainly during the sunlight period when most of them are active, not infrequently at sunset, and occasionally in the early morning when other species are abroad. Butterflies have sometimes been rare, mainly owing to dull or wet weather; usually they have been reasonably common, and occasionally extremely abundant. Birds have never been absent and sometimes have been obviously numerous, including bee-eaters, swallows, swifts, and other insect-eaters. The butterflies have included common species which keep near the ground in considerable numbers, such as *Eurema* spp., *Mycalesis* spp., *Ypthima* spp.; Danaids and various Nymphalids, such as the abundant species of *Precis*, which fly slowly and openly; Lycaenids and Pierids in great quantities; and a good many *Papilios*, some of which fly very fast though others settle on damp places, while the splendid *brookiana*, and other "bird-wings" visible two hundred yards away or more, soar easily in the air. Many other rare or shy species appeared too from time to time; but the point is that these others appeared constantly and fearlessly in full view of birds of many species yet never once did I observe even an unsuccessful assault. Nor in this country are butterfly wings often found lying on the ground, and when they are there is no reason to connect them with any bird attack on a flying individual. "Beak marks" are very uncommon; and many tropical birds, though not all, seem to rest during the mid-day hours when most butterflies are active. The wings of old butterflies are ragged because of what engineers call "fair wear and tear." Bite marks indicate attacks by lizards and such like upon resting butterflies.

It may be added that dragon-flies are very numerous here; but I only saw one case of a dragon-fly attacking a small butterfly, a Lycænid. The attack was successful; my companion and I saw the butterfly in the dragon-fly's jaws.

Two occasions most favourable for observation may be mentioned in a little detail. On both the sun shone brilliantly, at least for the greater part of the day; in Malaya cloudy afternoons often follow brilliant mornings.

On February 17th, 1935, clear sky and strong sunshine brightened a large water reservoir surrounded by jungle at Bukit Mertajam. Small streams feeding the reservoir, sunlit and shady paths, and a number of flowering bushes increased the attractions which jungle and water have for butterflies. Many of these, both individuals and species, were about. They played, flitted, fed, and occasionally mated, some at the jungle

edge, others out in the open. All, especially the latter, were in full view of numerous birds of various species. Notable among these were a lot of bee-eaters, sometimes perching on some tall dead trees, sometimes soaring over the water, and doubtless hawking congenial prey from time to time. Swallows were there, too, and an occasional eagle and hawk. Tropical kingfishers, which do not all or always feed on fish, added their glowing colours to the scene. But not one attempt was made by any bird to attack any butterfly; though, most noticeably, great *Papilio amphrysus* butterflies, six inches across the wings, flaunted their black and gold far up and away from any trees.

But among the butterflies I caught there on that and other days were many which showed irregular marks of attacks on the hind wings; and various little *Lycænidae* had the tails at the ends of their hind wings waving like antennæ and presented a general back to front appearance when they sat at rest, this appearance being of course lost as soon as they took to flight. The obvious indication from both these groups of phenomena is that when at rest butterflies are liable to attack by all sorts of insectivorous animals, doubtless including birds. But alert and active, flying or ready to fly, they simply are not attacked, whether they belong to relatively unpalatable species or not.

The day mentioned above was a perfectly normal one for this country. The second occasion was abnormal because of the enormous quantities of butterflies about. On June 1st, 1935, my wife and I motored up to the hill station of Cameron Highlands, situated about 5,000 ft. above sea-level, stayed there two days, and returned on the 4th. On each occasion the road was alive for some thirty miles with swarms of the yellow Pierid *Eurema hecabe* L. Not only were they scattered all along the road, but there were dense clusters, in which the insects were packed with wings folded as usual, as close as sardines in a tin. Small groups consisted of twenty or thirty, others of fifty or more; many larger ones had anything from two to five hundred massed in an area, usually roughly circular, containing two or three square feet. The same abundance was evident not only on the roadside but in large areas in the neighbourhood, at Tana Rata on the Highlands, and in some notable butterfly haunts near the river which flows down the valley not far from the road.

The numbers in the large clusters were estimated by allowing fifty or a hundred or so to rise together into a net, counting them roughly, and comparing their appearance with the swarm that escaped capture. Captain H. M. Pendleton, Curator of the Selangor Museum, and the leading authority on Malayan butterflies, told me he had never seen so many *hecabes* before.

Swarms of Eurema hecabe *in Perak. The light areas in the foreground are huge masses of yellow butterflies seen in strong sunlight.*

Incidentally it may be remarked that at the time when my wife and I were there there was no sign of migration; I do not know whether it occurred afterwards.

In this valley, especially at a certain place where there are hot springs near the river, there were many other butterflies present too: *Catopsilia*, *Hebomoia*, *Appias*, among Pierids, Nymphalidæ of many kinds, common and otherwise, Lycænidæ in large numbers, and many large Papilios were flying about or settled by the roadside or near the hot sands and rocks that they love. Here, as usual, were seen over a hundred male *brookianas* together, mostly gathered thickly on a small patch of wet sand, others flying easily around, and all unconcerned and fearless about other organisms. This valley is haunted by many kinds of birds, especially at the lower end where the butterflies were most numerous. But despite their excessive abundance not one bird was seen to make any attempt at an attack. No wings were found anywhere, though a few *hecabes* were found drowned in ditches, probably beaten down by the heavy rains which fell at night and during one day in this period. And on this occasion I must admit that scarcely any butterfly showed traces of injury to wings, though we inspected hundreds in addition to the few we retained as specimens.

Other evidence is available in recent books on Malayan birds and butterflies. I have also collected much unpublished information from well-known entomologists and naturalists and other European observers

who have spent many years, some even a life-time, in Malaya; and have gained some from some intelligent local youths, mostly Malays. Some of these observers reported a few attacks. Drongos certainly take flying butterflies regularly; and about four other species do so, apparently less often. Anyhow, none of them are very common, and their total effect on Malaya's huge butterfly population cannot be great. And of the few attacks witnessed a considerable proportion were unsuccessful. This applies specially to the common bulbul, mentioned above. It is a lively bird but not a quick flier, and is noticeably dependent on fruits, especially of palms, for its ordinary food.

This mass of first-hand evidence confirms the results of my own observations; which is that attacks by birds upon flying butterflies are very infrequent in Malaya, and so afford no basis for any theory of butterfly coloration.[5]

This conclusion is also supported by other facts. Many Malayan butterflies fly, or can fly, very fast; by comparison with the speed of birds, well known or observable on still days by any motorist with a speedometer, many must do twenty-five or thirty miles an hour or more; in addition they manœuvre very skilfully in three dimensions, so that few birds can catch them unless they are crippled or worn out by sheer old age. Even slow butterflies can accelerate considerably when alarmed; many, such as the *Danaidæ*, are generally admitted to be unpalatable. Again, butterflies are largely wing and integument, except the muscular super-fliers, and are much less succulent than moths, beetles, bees, and other plump insects, and so less favoured as food, as Poulton has observed. And Poulton's *dictum* that "unpalatable forms are conspicuously coloured,"[6] even if only relatively true, applies to at least the majority of flying butterflies.

Butterflies at rest are quite different. There are many reasons for thinking them liable to attack by lizards, monkeys, tree shrews, birds, spiders and other insectivorous invertebrates; and many for thinking butterflies in this state seek protection in numerous ways. But that, as Kipling would say, is another story.

(*continued from next column*)

organs of the male, the female moth might still go on giving out her attractive odour and yet the whole creation of male moths would be able to say "The female moths have lost their scent."

The problem, therefore, is to discover whether the scent has gone or whether the sense organ of scent in the human being has in any way altered its capacity.

[5] Cf. R. C. Punnett. *Mimicry in Butterflies*; ch. xi, p. 41.
[6] *Colours of Animals*, 1890.

The Mystery of Musk.

By Dr. Josiah Oldfield.

There is a curious phenomenon which I do not think has received the amount of care which it deserves. It has been passed by as a curiosity and has been allowed to be forgotten without any attempt, as far as I know, to explain the cause of it, or to weigh its significance. It is within the memory of most people who are over fifty that, in their childhood, one of the most delightful of scents was that which was given off by the musk plant. Every village had its pot of musk. Every poet tended to speak of the musk fragrance. To-day, however, there is not a single plant with musk scent remaining. Throughout the world, apparently within the space of some ten years or less, a plant, which is grown more or less universally, has been apparently deprived of its power of producing scent.

What does it mean, this universal loss? This annihilation throughout the planet of a particular scent which, up to that time, was one of the commonest and best known scents in the vegetable creation. On the face of it the solution is either one of two things:—(1) There has been some alteration in the plant, so that it is no longer a scented plant; or (2) There has been some alteration in our scent organs, so that we can no longer appreciate that particular pitch of scent.

If we take the first possibility, is it within reason that some change has taken place in the atmosphere of our globe, which has so affected the electrical or etherical conditions of the earth that the particular harmony which we call the musk scent has been terminated and can no longer exist? If we assume that every scent is a sequence of vibrations and a harmonious combination of these vibrations, we may then consider the possibility of conditions under which these harmonies cannot exist; but for this to take place there must have been some small, but none the less important, alteration, in the electrical or etherical forces at work on the planet which has put an end to this particular set of harmonies.

We are all conscious that the human ear cannot hear certain high-pitched notes, or see certain manifestations of light, or smell certain combinations of scents and, therefore, it is just as possible that the change may be in the human race as in the musk plant.

We recognise that a female moth will attract male moths from apparently miles away and this, as far as we know, as a result of the odour which proceeds from the female moth. This concept of scent postulates not only the production of the odour in the female, but the appreciation of it in the male. It is, therefore, quite within reason that, if some alteration took place in the

(*continued in previous column*)

Motor Haulage in the Far North.

THE use of mechanical transport, and the replacing of the old-fashioned methods of travel by plane or tractor, is a new feature of polar exploration. As will be seen in the following article, the use of tractors is still, in most cases, at the experimental stage; but great advances have been made since Captain Scott took motor-sledges to the Antarctic in 1910.

For the last seven years Starratt Airways and Transportation, Ltd., of Hudson, Ontario, have been carrying out big winter haulage jobs, with the aid of tractors, over the treacherous and difficult winter surfaces in the Patricia district of Northern Ontario; and with the discovery of gold at Pickle Lake and Crow River, this method of transport has taken on added proportions and a new significance. In the small amount of space available it must suffice to describe the work of freighting as it is carried out today in taking as an illustration the account, compiled from a report by Mr. Starratt, of a journey made from Savant Lake station on the C.N.R. (a Hudson's Bay Company post known earlier as Bucke or Bucke Post) to Pickle Crow gold mines, a distance of 124 miles. This journey is only one of many, but has been singled out as typical of its kind, and because it serves to show the proposition the pioneers of tractor haulage were up against.

30 h.p. "Cletrac" fitted with snow shoes for deep snow.

[*Photo: R. W. Starratt.*

The five tractors carrying seventy tons of equipment, left Savant on April 6th, to be followed two days later by seven horse-teams carrying nineteen tons. The weather conditions were not propitious, as slush had resulted from a thaw a few days earlier; and this had been followed by cold weather forming ice about two or three inches thick; and finally by a heavy fall of snow. Underneath the ice, which was not thick enough to bear the weight of the tractors, was one to two feet of water.

From the time the first lake was crossed one mile from Savant Lake at Steel until the expedition came to Pickle Lake, there was never a time when the whole load could be taken in one trip. The first serious trouble was met with at White Throat Lake, about 40 miles from Steel. In spite of careful testing of the ice after several loads had crossed the lake, a tractor and two loads fell through the ice into 10 ft. of water. After two days' hard work, however, everything was recovered, with the exception of a mining shovel. Conditions were, at that time, made still more difficult by another fall of snow, and sometimes the party covered only 1½ miles a day. Owing to the treacherous condition of the ice, it was impossible to travel at night. The next mishap occurred while the expedition was crossing Peddler's Path Bay, near Lake St. Joseph, 70 miles from Steel. At this point two tractors and one load broke through the ice, and it took one and a half days to recover them. The weather then became milder, and during the first three miles on St. Joseph, the going was good, with 18 in. of water on the top of the ice. Heavy slush was then encountered with about 18 in. of water between the slush-ice and the blue-ice underneath; in order to break the slush-ice it was found necessary to put two tractors on one load for a distance of six miles; and it took four trips to get the whole equipment over this difficult patch of surface.

At this point the tractors were overtaken by the horse-teams which had left Savant two days later, but which had been able to make better time over the slush ice, as they did not break through the surface crust. Conditions on their return journey were much worse, and on the way back to Steel one team broke through the ice, but fortunately was rescued. The ice was so bad that it was necessary at certain points to unhitch the horses and proceed in single file. These incidents seem to prove, beyond a doubt, the advantage of motor-tractors over horse haulage in these conditions.

The expedition, with all the equipment and supplies, were on Pickle Lake by April 23rd, and found the best surface of the entire trip, three miles being covered in thirty-five minutes, with full loads. Few further

difficulties were met with, and all the freight was delivered at its destination on April 25th. All the transport equipment was left at the property, as it was thought unwise to risk a return journey after this successful fight against time and weather. One tractor was sent back, but this unfortunately was lost through the ice whilst crossing Peddler's Path Bay. All the men were taken back to Hudson by plane.

Various kinds of tractors have been used by the Starratt Company. Of the "crawler" type, the "Cletrac," built by the Cleveland Tractor Co., Cleveland, Ohio, was found to be the best adapted to winter service in Northern Canada. On the "Cletrac 35" Diesel model a low-pressure heater has been attached to the cooling system and, when the tractor is stopped for the night, this heater is lighted and will burn for eight hours, maintaining the fluid in the cooling system at a temperature to keep the entire motor warm in any sort of weather, and permit of easy starting. This, needless to say, is very important in low temperatures.

The "Cletrac" is an exceptionally well-built machine, with a high-speed motor reducing vibration, which in turn prolongs the life of the whole machine. A tractor equipped with a heavy-duty, slow-turning motor, will, owing to vibration, shatter ice over which a high-speed machine will pass safely. Another important feature of the "Cletrac" is the split front sprocket, a design adapted to slush conditions. For winter service, all tractors should be equipped with open or skeleton track, especially for slush, and the track should be adjusted to run as slack as possible wherever slush is encountered. It is impossible to operate a tractor with a tight track in slush or wet snow.

Motor Snowshoes.

Machines should be equipped with standard ice grousers. It has been found necessary at times in making a road over particularly difficult ice to remove the ice grousers and replace them with snowshoes. These are made of angle iron, and will carry the machine over soft places, which, if tramped and left to freeze, make an excellent road.

Two types of snow-ploughs are necessary; one, a "push" plough for use on the lakes, the other a "pull" plough for service on the portages. The tractor works inside and behind the push plough, while the pull plough is hooked on to the rear of the tractor. This equipment, designed and built by the Starratt Transportation, Ltd., is a "trifle different," but, as Mr. Starratt says: "Necessity knows no law—and it works." When the surface is rough and uneven the pull plough cuts off the high spots and deposits snow in the depressions. The push plough is useless on a ground haul; the nose digs into the low places and soon renders the road impassable.

Built of oak, the freight-sleighs are 4 ft. wide between the runners. The base of the runner is moulded quarter round, and is shod with a heavy concave steel shoe. The rounded shoe holds the road where the flat shoe slews. The length of the runner varies from 6 to 8 ft.

If the strength of the ice is doubtful, the load is restricted to five tons per sleigh; and one or two men always go ahead testing the ice. If there is a current underneath, the thickness of the ice may vary from day to day. At a given spot a foot of blue-ice may occur; a week later there may appear open water. Another menace, calling for ceaseless vigilance, especially in this part of the country, are the so-called "loon-lakes." In these lakes, decayed vegetable matter in suspension near the surface generates gases, which, rising, rot the ice very rapidly. A fall of snow renders the camouflage complete, with but a crust of ice underneath. Equipment lost in these lakes is very rarely salvaged.

Spare magnetos should be carried in the event of a tractor going through the ice. All that is necessary after it has been removed from the water is to drain off all the oil and petrol, remove the sparking plugs, and turn the motor over by hand. This will blow all the water out of the cylinders. Put on the dry magneto, and with fresh oil and petrol the tractor should be ready to go again.

The Pioneer Spirit.

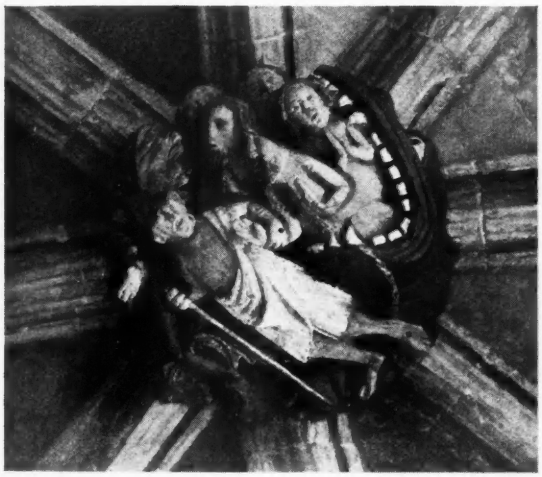
In no circumstances should a cab be used on a tractor in conditions similar to those found in the region described above, where bad ice is likely to be encountered. Mr. Starratt's tractors have gone through the ice on many occasions, but he has never lost a driver. At least two tractors should keep together to help each other over the bad places. Lastly, the success or failure of winter tractor operations under Arctic conditions lies in the hands of the personnel of the tractor crews. Battling slush on lakes and snow on portages calls for experience, stamina, and fortitude. All these qualities have played their part to good effect in the establishment of regular tractor transport in Canada's northern lands.

(The material contained in this article, adapted, by permission, from *The Polar Record*, has been obtained through the kindness of Mr. V. Stefansson, Mr. Wallace Laut, the Editor of *Gold*, and last, but not least, Mr. R. W. Starratt, the President and General Manager of Starratt Airways and Transportation, Ltd., who has been intimately connected with the problem of motor transport in the north since the old days of the snowmobile. To them we tender our very hearty thanks.)

The Restoration of Norwich Cloisters.

By E. C. Le Grice.

NORWICH Cathedral is famous for many remarkable features not found in any other cathedral, and in particular for a wonderful series of bosses. There is no other cathedral in the world which has so many carved bosses and so many in a state of perfect preservation. Altogether there are about 1,200, and not the least interesting are those in the Cloisters. Norwich Cathedral possesses the largest monastic cloister in England, and the only one with an upper story. The original Norman cloister was pulled down and rebuilt between the years 1300 and 1450, and until recently was covered with the grime of centuries. The Friends of Norwich Cathedral have begun the work of repair and a start has been made on the East Cloister. The work has been

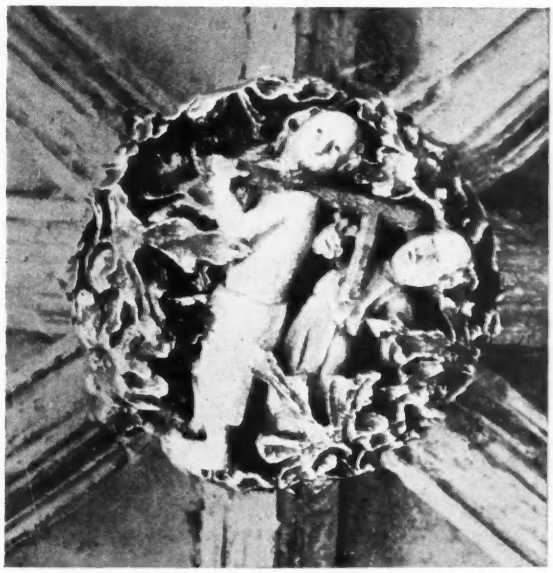


entrusted to Professor Tristram, whose great skill has been responsible for the restoration of the ancient paintings in the Cathedral.[1]

Several bays have now been completed and the wonderful work has been revealed in all its beauty. The north-east bay was first restored because of the glorious door giving entrance to the cathedral from the cloisters. As a result of this cleansing the door can be seen, for the first time for centuries, in all its beauty. Over the door are seven figures. Professor Tristram found traces of the original colouring, which he has most skilfully restored to its pristine hue, as far as it is possible to judge.

In addition to the bosses representing leaves, fruit, acorns, grapes, etc., all beautifully carved and coloured, a large number consist of groups of figures or of single

Three sculptures from Norwich Cloister: above, St. John the Evangelist with the Eagle; left, The Harrowing of Hell, with Christ leading forth Adam and Eve; below, The Bearing of the Cross (note the Roman soldier with a handful of nails).



figures. There is a very fine boss of the Crucifixion, and a remarkable example with two musicians playing the pipe and tabor, of which more will be heard.

The author acknowledges the assistance he has re-

[1] See DISCOVERY, XV, p. 271.

ceived from the writings of the Dean of Norwich, who will be glad to accept assistance towards the work of restoring his cathedral buildings to their original beauty.

The March of Knowledge.

Untarnishable Silver

The recently-discovered "rhodanising" process for rendering silver untarnishable by the use of rhodium, is comparatively simple to operate, and can be applied to old as well as new silver. It is expected to be popular because it eliminates cleaning and enables silver to be displayed without its appearance deteriorating from day to day. Unlike the lacquers and varnishes hitherto used, the rhodium finish is unaffected by heat and does not chip or crack. Until a few years ago the world supplies of rhodium—one of the six platinum metals—were very limited, but Canadian production has recently been extensively developed.

Uses of Niobium.

The uses of another rare metal, niobium, are reported in a recent issue of *Sands, Clays and Minerals*. Very little of this element is available for research purposes, but it is believed to have a close resemblance to tantalum in its general properties ; and in colour is practically the same as platinum. Commercial production of niobium is naturally restricted by its rarity, but an American firm is exploring, among other possibilities, the use of this metal as a stabiliser for stainless steel. It is said also to have proved suitable for electrode material in wireless valves.

Excavation in Syria.

Sir Leonard Woolley's report, in *The Times*, of his first month's excavation at the mouth of the Orontes, in Syria, holds out great hopes that the original expectation of finding new material to illustrate the connections between Asia and Minoan Crete will not be disappointed. Up to the present Sir Leonard reports nine occupation levels in the mound which he is examining ; a remarkable feature was the complete blank for the period from *c.* 300 B.C. to *c.* 250 A.D.—corresponding to the era of prosperity of the rival port of Seleucia a little to the north.

What Pottery Reveals.

The sudden appearence, in an earlier level, of pottery of " Cypriote " type leads to an interesting speculation. Ware of this type appears with equal suddenness in the island of Cyprus itself, and if it can be proved that the mainland examples are earlier than those on the island, this will point almost certainly to an invasion by a race from the East with this culture well developed. The persistence of Greek influence throughout the period of the Greco-Persian struggle throws an interesting light on the position of commerce during that war ; a flourishing Greek colony must have maintained itself throughout the war on what was an enemy coast.

Synthetic Radium.

By means of the apparatus installed at the University of California, Berkeley, for splitting atoms (says the California correspondent of the *Electrician*), deutron particles have been fired at 12,000 miles per sec. and have produced the first synthetic form of radium. This is one of the decay products of ordinary radium to lead. No therapeutic use for this synthetic radium E is at present known. It is claimed that this experiment provides the final proof that every element can be transmuted by the university's gaint cyclotron ; and the greatest hope is that it will be possible to produce the valuable radium itself, as the laboratory has already been able to obtain radio-active sodium.

Bombardment of Bismuth.

The radium E was produced by Dr. Livingood through the bombardment of bismuth, with deuterons at an energy of 5,500,000 electron volts. The deutron particles used were the nuclei of mass 2 hydrogen atoms obtained from heavy water costing £120 a pint. They are fired at the rate of 10^{14} per sec. Tests on the resulting radium E, produced thus far in only infinitesimal amounts, show that it possesses all the properties of the natural radium. It decays with a half life of five days by emitting electrons and is converted into polonium, which continues to decay for about 140 days. The end product is lead.

Soil Census.

A new apparatus, invented by Major W. Ladell, for taking a census of the invertebrate inhabitants of the soil, was demonstrated at the annual inspection of the Rothamsted Experimental Station, Herts. By employing the effervescent properties of Epsom salts the insects, etc., are forced to the surface of the required sample of soil, and the quantities discovered have been remarkably large—over 45 million to the acre in 9 inches depth in unmanured soil, while in manured soil, under favourable conditions, the total may rise to 190 million per acre. The chief practical value to agriculturists lies in the estimate it will now be possible to make, with a great degree of accuracy, of the period of efficacy of various insecticides.

Radiation Measurement by Neon Circuit

By Dr. A. Stäger

WHEN experimenting with a normal single Neon-lamp circuit I have observed that the frequency of the oscillations under certain conditions depends upon the radiation which strikes the Neon lamp.

In Fig. 1 the part on the right hand side of the line l-l' shows the familiar circuit. The battery B charges the condenser C through the potentiometer P and the resistance R. The condenser is periodically discharged through the Neon lamp N. L is a source of radiation, which emits visible light, infra-red light, ultra-violet light, and gamma or X-rays.

Most of the commercial Neon lamps are suitable for the experiment, especially those with photo-electrically sensitive electrodes, but even a Neon lamp with iron electrodes may be used. The resistance present in the socket of the commercial lamps should be removed. In one of my experiments I have used a condenser having a capacity of 1 microfarad and a resistance of 250,000 ohms. In an absolutely dark room I have set the potentiometer so as to tap a potential which was very near or just below the flash potential of the Neon lamp. This potential exists when the lamp gives very infrequent flashes, *e.g.*, one or two per minute. Under these conditions the circuit is photo-sensitive. This can be proved by lighting a match at a distance of a few yards from the Neon lamp. The light from the match immediately raises the discharge frequency. When the electric lamp in the room is switched on the frequency is further increased, and in full daylight it is raised still more. There is, however, a maximum value of the frequency for the given data of the circuit.

It is not difficult to explain the phenomena. The light quanta striking the photo-sensitive parts of the electrodes liberate electrons. The freed electrons move in the electric field of the lamp and produce ions by impact, which, in turn, produce further ions. It is easy to understand that in this way the flash point will be reached earlier and at a lower potential than in the dark.

In Fig. 2 the dash-line curve represents the potential at the condenser as a function of the time; when no discharge occurs this line would approach the potentiometer potential V_p after a very long period. However, in the dark the Neon lamp discharges when the "flash potential in the dark" V_d is reached. The resulting saw-shaped curve is traced in full in the diagram. When light strikes the Neon lamp the discharges occur at the lower potential V_b ("flash potential in the light"). V_l is the extinguishing potential. From the diagram it will be seen that the dotted saw-shaped curve produced by the illuminated Neon lamp has a higher frequency than the curve in the dark.

Instead of illuminating the Neon lamp it is also possible to make use of an ionisation chamber (I in Fig. 1).

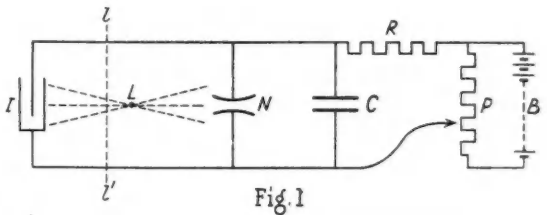


Fig. 1

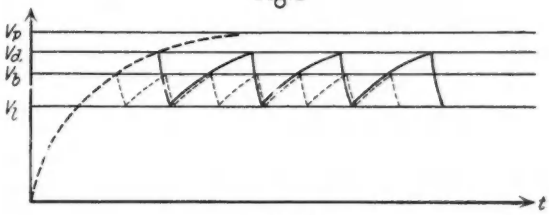


Fig. 2

1. *The ordinary Neon Lamp circuit.*
2. *Diagram of the oscillations under varying conditions.*

When ultra-violet light is to be measured this chamber will, of course, consist of a glass bulb transparent to this form of radiation, and inside photo-sensitive layers will be necessary. When penetrating radiation is to be measured a metallic ionisation chamber can be used. When the radiation is of a low density a large chamber, of perhaps a square yard surface, could be used. Its capacity does not matter, as it will be small compared with that of the condenser. Whereas the radiation striking the Neon lamp directly increases the frequency of the oscillations, the contrary occurrs when the radiation strikes the ionisation chamber.

The use of the Neon circuit is not restricted to the measurement of radiation. It can, on the contrary, be adapted also to the measurement of resistances of any kind. For instance, in place of the ionisation chamber a high resistance wire can be used. The frequency of the oscillations will depend upon the resistance. When a wet string or a piece of wood is used in place of the ionisation chamber it will be possible to measure its humidity. It would even be possible to use the Neon circuit as a voltmeter or ammeter.

In our June issue, on p. 178, the title of the article *The First Natives of South Africa* should be *The First Bantu Settlers of South Africa.*

Timber Humidity Measurement.

By V. Sinclair.

The new electrical method of measuring the moisture content of timber, described in this article, goes far towards solving an urgent problem. Not the least attractive aspect of this new system is its simplicity of operation.

WHEN "seasoned" timber was spoken of in the old days before the War, it was generally understood that the wood had been stacked in the timber-yard for years, if not for tens of years, where it remained until it was seasoned or dried by exposure to the air. There was never any doubt that furniture, window-frames, doors, panelling, patterns, musical instruments, housings for apparatus, and other articles of the kind, purchased in those times, were made from such timber—timber from all parts of the world stacked in the timber-yards by the fathers, if not the grandfathers, of the vendors. Then it was that joiners' shops, furniture factories, and other wood-working establishments bought wood which had an implied warranty that it was well seasoned, and suitable in every way for the products into which it had to be fashioned.

Post-War Conditions.

But the outbreak of the War initiated a new era, in which economic conditions underwent as great a change as thought and behaviour. It is no longer possible to lock up capital in timber-yards for such long periods as before, involving loss of interest which can ill be afforded; apart from that, during the War the timber-yards were raided for pit-props for the trenches, and afterwards all the wood that could be obtained was required for making good arrears in housing and furniture, with what results many people know to their cost and inconvenience. From all this it has come to be understood that the statement that timber has been seasoned by exposure to the air no longer bears the same meaning as before, namely, that it has been properly dried out and is necessarily suitable for commercial use. Concurrently, science stepped in and introduced timber-drying kilns, in order to attempt to achieve in a short time what nature and our ancestors required years to do.

But timber which has been exposed to the air for relatively short periods, or has been artificially seasoned, is always subject to an element of doubt in regard to its moisture content and, therefore, to its suitability for the purpose for which it may be required. This must be so from the nature of things. If the moisture content is too high or too low, the finished goods will warp or shrink and their appearance and life will be prejudiced. This applies, of course, not only to stocked goods but to articles already put into use, and in any case the result is dissatisfaction. These changes in appearance and shape can be obviated if the moisture content of the timber approximates to the mean humidity of the atmosphere in the country or locality which is to be the ultimate destination of the finished products, so that it has become necessary to know, with more or less precision, what the actual moisture content is, not only to prevent early deterioration or change of shape, but also in order to be able to obtain optimum results in the processes of impregnation, staining, bending or artificial drying.

Here again science has provided the necessary means. During the last few years several methods of measuring the moisture content of timber have been evolved, including electrical ones. Unfortunately, the results obtained with these methods have been neither positive nor reliable enough to fulfil all the requirements of actual practice, such as an adequate range of moisture content, an apparatus which can be used by unskilled persons, a rapid method of measuring, small measuring errors, a robust instrument, etc. In regard to electrical methods, it will be obvious that the higher the moisture content, the lower the ohmic resistance and therefore the larger the current that can be passed, so that, in principle, conclusions as to the amount of moisture can be drawn from the strength of current flowing. But well-seasoned timber as required for precise work such as joinery, musical instruments, and so on, is a very poor conductor of electricity because its moisture content is low and its ohmic resistance therefore high, so that the current that can pass is very small. Hence, it follows that the accurate *direct* measurement of such currents is rather more of a laboratory proposition than a practical one.

Rapid Electrical Measurement.

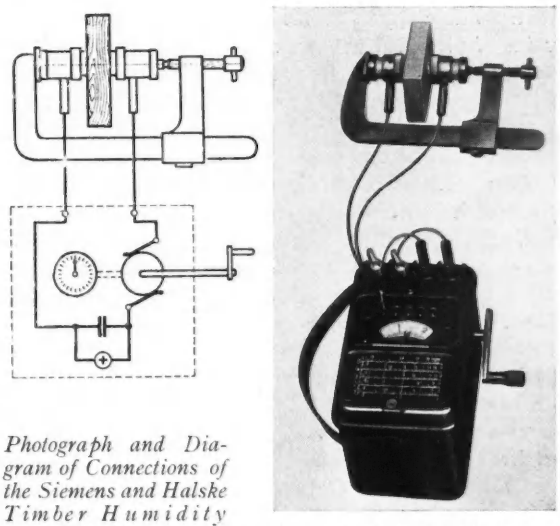
This difficulty has now been overcome by a new method and instrument, a so-called Timber Humidity Meter, which has been evolved in Germany by Messrs. Siemens & Halske in collaboration with the Timber Research Station of Berlin. The principle of this instrument (which, as will be seen from the illustration, has the appearance of a Megger) is based on indirect measurements of the ohmic resistance of timber, which is proportional to its moisture content, and the instrument permits of the rapid and accurate determination of this condition in values per cent. It consists essentially of

a black bakelite case containing a magneto-generator which is driven by a folding handle, five condensers, a gas-discharge lamp, a small counter mechanism, a ferruled electrode holder of the clamp type and the electrodes. The latter consist of rubber buffers which have to be covered, for each test, with the sheets of tinfoil provided with the instrument, the test piece of timber being secured between them in the holder.

The magneto generates a direct current at 500 volts, and this is passed through the test piece until the condenser in the circuit that is in use is fully charged, as indicated by the glowing of the lamp. The number of turns of the handle required to bring this about is integrated by the counter mechanism and shown by the pointer on the dial, this number being a measure of the time taken to charge the condenser. The moisture content is then read off on a panel on the top of the instrument which is directly calibrated in percentages. In order that the time required to charge the condenser should be as short as may be consistent with accuracy, the instrument is provided with five condenser circuits, each of which can be put in series with the generator by means of a plug commutator, the gas discharge lamp being in parallel with the condenser circuits. Each circuit has a different range, corresponding to the five more general degrees of moisture to be measured, whilst five relative scales on the panel indicate the percentage moisture content for each number of revolutions.

The method of operation is as follows. After clamping the test piece of timber (which should not be less than 50 by 50 mm.) between the electrodes and connecting these to the two plug terminals on the right of the instrument by means of the leads provided, the pointer of the counter mechanism is set to zero by laying over the right-hand lever. The travelling commutator plug is then inserted into the first socket, which corresponds to scale 1 on the panel, and the crank-handle is turned until the lamp glows, whereupon the counter mechanism must be immediately locked by laying over the left-hand lever. Should the lamp glow immediately the handle is turned, this is an indication that the test piece is very moist, and no adequate reading can be obtained from scale 1. The right-hand lever is then actuated again to set the counter mechanism to zero, the plug is removed and inserted in the socket corresponding to scale 2 and the measurement is repeated. If necessary, this scale also is discarded for the next, until a reading of adequate accuracy is obtainable, the percentage moisture content corresponding to the indication of the pointer being then read off on the scale which is in use.

The measuring range of the Timber Humidity Meter covers a moisture content of from 5 to 22 per cent., which is considered ample for all measurements likely to be required in practice and for any kind of timber which may be offered for working-up purposes. The measuring accuracy of the instrument also conforms to all reasonable and practical requirements, the maximum error being ± 1 per cent. for a moisture content below 12 per cent. ± and 2 per cent. for a moisture content above 12 per cent. This range of error applies to all timber between 10 and 100 mm. in thickness (about 0.4 and 4 inches), whilst the nature and section of the wood have no bearing whatever on the measuring accuracy. Hence joiners, cabinet and furniture makers, and musical and scientific instrument makers, are assured of reliable measurements of the moisture content of any class of wood that they may use for their products, no matter what its section may be, within the practical limits stated. The standard calibration of the instrument, however, is for matured timber, and it should not be used for green wood.



Photograph and Diagram of Connections of the Siemens and Halske Timber Humidity Meter, showing a test piece of wood in the Electrode Clamp.

From the foregoing it will be realised that only a few manipulations are required to make a measurement, that this is easily read off on the scale, and that a whole series of tests may be undertaken in quite a short time. The instrument is readily portable and simple to use and the measurements can be made by unskilled labour so long as average intelligence is applied to the reading of the scales. Moreover, as it contains no sensitive parts, there is no risk of the instrument becoming damaged due to faulty manipulation, so that it should afford a useful and practical means, in all wood-working establishments, of determining the condition of the various classes of timber employed.

Electronic Music.

By Major R. Raven-Hart.

The electrical production of music is an accomplished fact to-day, and although lovers of the art may stigmatise it as "canned music," it is far from being merely that, as the need of a skilled human interpreter remains. But electrical instruments will not come into their own until a large repertory of music has been composed specially for them.

RATHER than approach this subject from the theoretical point of view and end with the practical applications, it will probably interest most readers more to start with a description of some of the instruments in use to-day, and work back from them to the principles on which they are based.

First, then, the Martenot instrument, named after its French inventor, and perhaps the most used at the moment: Honegger, Milhaud, Ibert are among the composers who have scored for it, and Stokovski has made use of it in his orchestra. Like most orchestral instruments it plays one note at a time only: unlike them, however, it can hold a note for as long as is wished, without breaks for breath or bowing, and produce any degree of volume desired practically without change of timbre.

As the photograph shows it is quite small, as portable as the smallest harmonium: the case contains everything except the loudspeaker, from which the sound comes, not shown in the photograph. There are two methods of playing. In one the player slips a finger into a ring attached to an endless cord, and moves this finger over the keyboard, in this case a mere dummy to show him where the notes lie: it is important to notice that he is not tied to the notes of the modern "tempered" scale but can produce any intervals, quarter-tones, etc., at will, by not putting his finger exactly over the centre of the dummy key. His left hand works an "on-and-off" key, sounding the note when it is pressed and killing it when released: the musician will note, therefore, that if he releases this key while moving the playing-finger he will be detaching note from note, but that if he holds the key down and moves the finger he will be producing a true *glissando*.

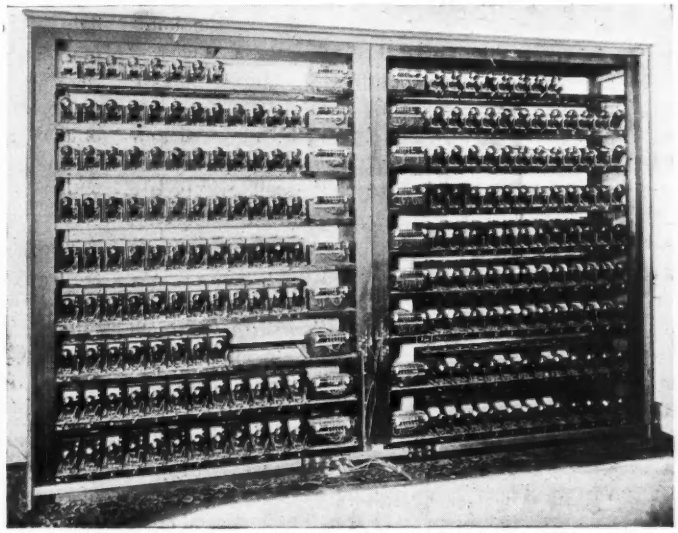
In the other method he tucks the band out of the way and uses the keyboard, playing one note at a time (but, of course, not using one finger only, any more than one does on a typewriter). He has now lost the true *glissando*, and is tied to the modern scale; but he has now available a true *legato*, with absolutely no break from note to note, previously impossible however quickly he moved the ring from position to position. (It should be added that the keyboard is not fixed in position: he can press it slightly sideways with the playing-finger and thus still get smaller intervals than the normal, but less conveniently than with the ring: the chief value of this movable keyboard is to give a true *tremolo* with keyboard playing, as well as the usual trill between adjacent keys.)

Playing the Miessner instrument. The inventor's left hand is on the "stops" controlling tone-colour, his foot on the volume-pedal.

Volume is controlled by that same "off-and-on" key, since the more it is depressed the louder is the sound from the loud-speaker. This obviously implies that the sound builds up from silence to strength (incidentally, if wished, to a strength capable of dominating the full fury of the orchestra, since it is merely a question of the power-handling

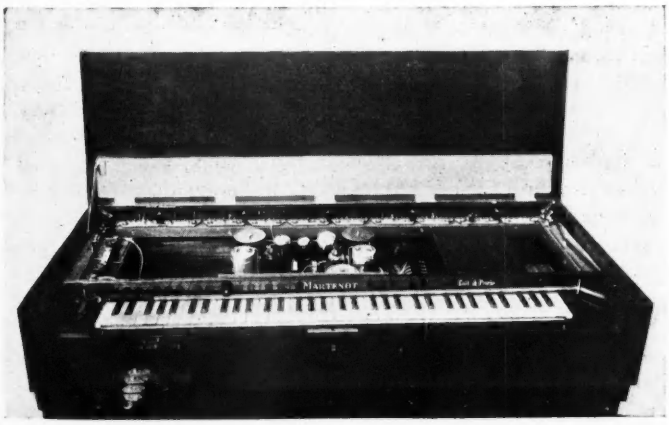
capacity of amplifier and loud-speaker); a special key can be used, however, when a harsher "attack" is wanted, more like that of a trumpet, for example.

As to the principle, perhaps you may remember the old simple wireless receivers with a "reaction" knob. If you tuned to a transmission and turned this knob too far, your set howled at you (and at your unfortunate neighbours), and very slight changes of your tuning-condenser would change the pitch of this "musical" note. Technically speaking, you were heterodyning an oscillation produced by one valve (at the transmitter) by another produced by a second valve (in your set), and the mixture gave an audible note. This is the principle of the Martenot, as in fact of nearly all the early instruments that came into public notice, except that both the oscillating valves are contained in the instrument itself, as is also the amplifier building up the sound they produce before it reaches the loud-speaker; and that, instead of making very small changes in your relatively large tuning-condenser to change the pitch, much larger changes in the setting of a much smaller condenser are used to do this.



This cupboard full of valves replaces, in the Coupleux electric organ, the pipe-chest of the ordinary organ. The small knobs in the centre are for tuning, a very rapid process compared with the tuning of an organ-pipe.

What the music sounds like depends on other keys, also controlled by the left hand, which work chiefly by adding filters in the amplifier: perhaps the weakest point of this particular instrument as compared with others to be dealt with is that the range of tone-colour is not very great, pure tones like those of a flute being on the whole the most satisfactory.



In the Martenot the endless band is seen at the back of the keyboard and its finger ring on the left. The wooden key in front controls "off-and-on" and volume, the knob serving to lock it. The other switches are for tone-colour.

As a second instrument we will choose a very different one, the electronic organ in use in a number of French churches and at the "Poste Parisien," and built by Coupleux (who, incidentally, is an old-established builder of normal organs also). Here there is a valve for every note in each of the several manuals and pedal range: overwhelmingly huge compared with the harpsichord-like Martenot, but ridiculously small and cheap compared with the normal organ. Here, of course, as many notes can be sounded simultaneously as desired: on the other hand only the notes of the present "tempered" scale are available, and true *tremolos* and *glissandos* are impossible.

Some of the advantages of these organs may easily be overlooked. For instance, only the console and the loud-speakers need be in the church, the valves and associated circuits being tucked away in a cupboard somewhere, a most important point where the normal "kist of whistles" would spoil the architectural effect; a new register can be substituted for an old one in a few minutes, by simple

electrical changes; tuning is very rapid; the loud-speakers can be concealed and, a vital point, placed so as to suit the acoustics of the building; an echo-organ, or an organ at the west end to support congregational singing, means only extra loud-speakers instead of new boxes of pipes; the response to the player's finger is much more rapid than normally; swell effects are obtained by a volume-control like that of a receiver, not by clumsy mechanical shutters, and can thus be fitted to all manuals.

The principle here is less obvious to the untechnical. We talked of a valve "oscillating" when given too much reaction: we meant that it was producing currents which change their direction hundreds of thousands of times a second. If such currents were fed to a loud-speaker it would ignore them, its coil not being able to move so fast: if, however, we could slow them down to, say, a thousand reversals a second only, the coil would be able to move with them and so produce a musical note, the pitch depending on the number of reversals. We can do this by replacing the tuning-condenser and coil of our oscillating valve by a large fixed block condenser and a large iron-cored coil: in the Coupleux organ each valve has such a coil and condenser associated with it, so proportioned as to make the valve oscillate at the frequency, the number of reversals per second, which will produce the note that this valve is required to provide.

Like a normal organ, this instrument has many stops: these change the tone-colour chiefly by adding filters in the amplifier, the original note produced being deliberately made very rich in overtones, which in turn are filtered out as required.

Electronic Pianos.

Another group of instruments acts by producing a sound mechanically and then dealing with it electrically. As an example the electronic piano of the Bechstein firm, or that due to Miessner and Vierling, can be quoted. Here you start with a perfectly normal piano keyboard, and the hammers strike the strings normally; but then the sounds are amplified and "dealt with" electrically before they are heard from the loud-speaker. Here again as many notes can be sounded simultaneously as wished; but here again is the disadvantage that only the notes of the modern scale can be produced.

There is more in these instruments than appears at first sight. Not only can the tone-quality be very considerably altered during amplification, by filters, or in the case of the Miessner piano by blending the various wave-forms picked up electrostatically at various points along the string, but also, since the strings are not now required to give off much sound, they can be lighter and less tensioned, and (the important point) much less damped. Hence a held note lasts far longer than on a normal piano; and, since the volume is now controllable not only by the initial force of the finger but also by a pedal-operated volume-control in the amplifier, this note can be made to change in strength while it is being held, obviously an impossibility with the normal piano.

Finally, there is the instrument which, to the writer, is the most important in its possibilities, namely, the Trautonium, due to Dr. Trautwein and developed at the Charlottenburg Music High School (Conservatoire), where it so interested Hindemith that he not only wrote for it but even himself learnt to play it. Like the Martenot it plays one note only at a time, the player pressing down a stretched wire to touch a metal plate. The position of the finger along the wire fixes the pitch, the pressure of the finger controls the loudness, a subsidiary control of this being by pedal. Obviously any intervals can be sounded, "tempered" or not: by sliding the finger along the depressed wire a *glissando* is given; by lifting it and placing it elsewhere the notes are detached; and by preparing the next note with another finger this follows with a true *legato*. This concentration of everything under the control of the player's finger is an advantage over many other instruments, *e.g.*, the Martenot.

Employing the Neon Circuit.

The principle here is entirely different again. If you take a neon lamp, a miniature version of those used in electric signs, and connect it to a condenser and a resistance and a source of current it will flash at regular intervals, and each flash causes a click in a loud-speaker in an associated circuit. By altering condenser or resistance the speed of the flashing can be increased until the eye cannot follow it, and at the same time the clicks will build up into a musical note, just as do the clicks of a stick along railings if the small boy runs fast enough. Further small changes of resistance or condenser will then alter the pitch of this note.

In the Trautonium it is the resistance which is altered by changing the point of contact of wire and plate, giving about $3\frac{1}{2}$ octaves from one end of the wire to the other: the condenser is changed only to shift these $3\frac{1}{2}$ octaves elsewhere in the scale—and they can be put so low that the "note" goes back into its separate clicks again, or so high that most human ears cannot follow it (cats hate these).

The really interesting thing is, however, the change of tone-colour available, which is far more than on any of the instruments yet described. This is obtained by adding highly-damped oscillations of a higher frequency

The Trautonium. The tabs near the wire are merely guides, like dummy black keys. The various knobs control tone-colour, volume being controlled by the pressure of the finger and by the pedal. More elaborate models are fully enclosed.

which is *not* a multiple of the fundamental (in such a way as to disprove the Helmholtz theory pretty thoroughly, it may be added, though the matter is too technical to deal with here). Not only can all existing instruments be imitated by the Trautonium, but it possesses also the most uncanny feature of changing gradually from one imitation to another, not step by step as in the case of (*e.g.*) an organ. To hear a flute holding a steady note and little by little becoming a trumpet, passing on the way through all sorts of non-existent instruments, is marvellous indeed.

It must be emphasised that these are only four examples: there are any number of other instruments of the kind in use to-day, and conceivably some one of them may eventually develop into the most important. These four examples will, however, suffice to show that electronic methods of producing music offer vast possibilities, especially as regards facility of playing, range of volume up to the literally deafening without change of timbre, and, above all, variety of tone-colour.

A New Guinea Collection.

A collection of ethnographical objects made by Lord Moyne during a yachting trip to New Guinea last winter has lately been on view at 10 Grosvenor Place, S.W.1. The chief areas represented are the middle and lower Sepik and Ramu Rivers in the mandated Territory of New Guinea, the almost unknown Eilanden-Bloemen River region in south-west Netherlands New Guinea, and the Purari River Delta in the Gulf of Papua. The collection is supplemented by about 250 photographs taken by Lady Broughton, who was a member of the expedition. Of the results of the expedition by far the most interesting was the confirmation of rumours as to the existence of an unknown group of pygmies who were said to live on the Ramu river. These rumours were confirmed, and although the members of the expedition were not allowed to enter the villages of these little people, as they are "uncontrolled," the pygmies, to the number of twenty-five, came to the expedition to trade.

A Pygmy Race.

Lord Moyne measured both men and women pygmies and found for twelve men an average stature of 54½ inches, and for three women, an average of 51½ inches. The lowest stature for New Guinea pygmies previously recorded was 57 inches, a fact which had caused some anthropologists to question whether true pygmies existed in New Guinea at all; but the low stature now recorded confirms their existence as a distinct variety, and not as a mere local variant of the typical inhabitant of New Guinea. Several complete equipments of the pygmies were obtained and are shown in the exhibition. These include neck pendants, armlets, waistbands, and pubic coverings, as well as bows and several different types of arrow, each having its special function.

A Lancashire Abbey.

Archæologists attending this year's meeting of the British Association in September will have a special interest in the recent work of restoration which has been successfully carried out at Whalley Abbey, not far from Blackpool. Most of the abbey belongs to the new See of Blackburn, and a diocesan fund was opened to carry out an excavation of the site, partly with a view to helping the unemployed. The most interesting discovery is that of the abbot's house, the walls of which have now been exposed between the great kitchen and the east side of the cloister. The *Manchester Guardian* forecasts the possibility of still further discoveries on a part of the site as yet unexplored.

Book Reviews.

Getting Acquainted with Minerals. By GEORGE LETCHWORTH ENGLISH. (McGraw-Hill. 15*s.*)

The Book of Minerals. By ALFRED C. HAWKINS. (Chapman and Hall. 7*s.* 6*d.*)

Students of the natural sciences usually have the choice of two different types of books to aid them in acquiring knowledge of their particular subject. On the one hand there is the true text-book type, severely critical and authoritative; on the other hand, books which are written in more friendly manner by people who have derived great happiness and profit from some particular study, and, by reason of their life association, are equally, and often far more, authoritative.

Mineralogy is one of the most profitable of the natural sciences, and in the book under review, Mr. English introduces it in a very simple and most interesting manner, without sacrificing scientific accuracy. No previous knowledge of chemistry, physics or geometry is assumed, and such facts and theories as are essential to the understanding of minerals are presented in an alluring manner, for the author has been an enthusiastic collector of minerals since boyhood and has pursued the study and developed it as a life work, having been a dealer in mineral specimens as well as a professional mineralogist. His first chapter tells us why people who study minerals are so enthusiastic about them. His second chapter tells us how to collect: " Before you start out either to collect or to study minerals make up your mind that you are not going to be a quitter. It is foolish to begin and in a short time drop it. Mineral collecting and mineral study are too delightful to fall into the hands of anyone who will not treat them right."

After the foreword, we are introduced to the subject of chemistry in words which would materially increase the value of any known text-book in explanation of the reactivity of the molecules of chemical compounds. Here in the space of ten pages we learn all the chemistry which we need for a preliminary study of minerals. Succeeding chapters speak of hardness, which is an important characteristic in varying degrees of all mineral species; tenacity, which manifests itself in varying ways, such as brittleness; crystals and the subject of crystallography, which is treated so simply that it can be understood by a child of 14 years and yet its appeal is equally strong to the adult. With the aid of a potato, knife, pencil and ruler, Mr. English shows us exactly how an " octahedron " is formed from a " cube," and how the various crystal shapes of the six crystal systems are not really so complicated if you look at them from a different viewpoint. Cleavage and fracture, and forms of structure other than crystal forms receive explanation in turn, with a most delightful chapter entitled " Mineral Mimics " where Mr. English introduces us to such things as the so-called kidney ores of hematite, the grape-like form of chalcedony, the coral-like structure of certain aragonites, stalactites and stalagmites. With explanation of transparency, colour, streak, lustre, refraction and all the phenomena associated with colour, and some account of why minerals vary in weight, we reach the end of the first section of the book where the author believes " that you have now acquired a love for minerals and a desire to know more about them."

A second section of the book is devoted to a description of mineral species, all selected with great care as being those with which it is most important for the student to become acquainted. Here it has been thought best to adopt a classification based on the most important element in the mineral make-up (i.e. economic as opposed to systematic classification), those minerals which are of major importance as rock formers being separately grouped at the end. Rocks, of which the crust of the earth is composed, are dealt with in a third section, for " it is worth while to know something about the rocks " in which minerals are found. In an appendix we are told of the steps to be taken in identifying minerals, 30 pages of tables being provided for this purpose. This is followed by a useful " guide to pronunciation of mineral and rock names," complete with key and vocabulary, for "much difference of opinion exists as to how certain minerals' names should be pronounced." Throughout the whole of the book the author never wearies the reader. He speaks to you in a helpful manner, and, with a large number of excellent illustrations, the book fully justifies its title.

Mr. Hawkins's book is planned " to tell the people the story of minerals." It is written in a manner which attempts to overcome some of the technical difficulties of the subject. He tells us what minerals are, how and where they are found, how to collect them, how they were formed, and how to identify them from physical properties and tests. Crystals and crystal systems are briefly introduced in a chapter of only ten pages, followed by one devoted to " methods for making unknown minerals disclose their identity," and one on finding minerals in various types of quarries and mines. Chapter V, which comprises the bulk of the book, is devoted to a description of mineral species arranged according to the true systematic classification—native elements, sulphides, oxides, carbonates, silicates. There is also a useful bibliography of the principal text-books.

The book by Mr. Hawkins, however, will not appeal to so many people as will the book by Mr. English. It will nevertheless form a very useful companion to a collection of minerals, as a great deal of useful data is recorded and there is a large number of illustrations of typical mineral specimens. To show the different styles of the two authors it is useful to compare the words of identical sections, selected without prejudice. " Bornite," states Mr. English, " is another sulphide of copper and iron, Cu_5FeS_4. It contains 55.5 per cent. copper, much more than chalcopyrite. It is very much rarer, though in some mines it is abundant enough to constitute an important ore. Secure a specimen of it and break it. You will be amazed to find that on a fresh fracture it has the peculiar reddish brown colour of pinchbeck metal. This quickly tarnishes to a beautiful blue. No other mineral is like bornite in this respect." Now listen to Mr. Hawkins: " Bornite," he states, " looks like chalcocite, but has a reddish metallic appearance inside when freshly broken, and the outside is often covered with bright metallic colours, due to tarnish."

C. H. BUTCHER

Science in Antiquity. By BENJAMIN FARRINGTON. (Thornton Butterworth. 2*s.* 6*d.*)

A new volume, number 179, of the *Home University Library* is welcome proof both that this old-established series is still growing and that its high standard is well maintained. Professor Julian Huxley has joined Mr. H. A. L. Fisher and Professor

Gilbert Murray on the editorial board and will thus guarantee the soundness of the scientific contributions. Nothing at least could be better in its way than Professor Farrington's lucid and very readable account of the early development of science up to its virtual collapse under the later Roman Empire. Greek theories of the universe were but guesses at truth until the Ionian school began to base its teaching on experiment and to apply the accumulated knowledge of Egypt and Babylon: and then came Socrates and Plato with their contempt for the physical world to set philosophers against physicists and promote a reaction against experimental science which lasted until the Renaissance. It is true that isolated scientists like Archimedes of Syracuse and Hipparchus of Alexandria did some useful work, and Vitruvius, Varro and Pliny under the Roman Empire had much of the scientific temper. Still, the fashion set by the Platonists and supported by the Christian Fathers was to despise physical research, and thus the world had to wait many centuries before the truly scientific methods of the Ionian school could be resumed. Professor Farrington's little book deserves attention, apart from its contents, in that it warns us against assuming that progress in civilisation is continuous, whatever may happen and however little care is taken by mankind to maintain it.

A Bird Diary. By GODFREY HARRISON. (Dent. 6*s*.)

The author does not claim for this little book any scientific value; it is, he says, a real diary, not written for publication, "an act of gratitude for the happinesses the experiences recorded have given." His observations of birds have freshness and enthusiasm, and he is not afraid of acknowledging his mistakes. He first observed his birds and then looked them up in books; his identifications were seldom wrong, but when they were he candidly adds a note to say so. There are worse ways of learning your birds. The book is adorned with woodcuts by Robert Gibbings who illustrated *The Charm of Birds*. With birds such as sheld-duck, in whose plumage there are marked contrasts of light and shade, woodcuts are undoubtedly effective; but whether they are the best medium for bird illustration is a moot point.

Hedge Folk in Twlight. By PHYLLIS KELWAY. (Longmans. 6*s*.)

Whoever keeps wild creatures as pets gives hostages to fortune: their lives are so short. Miss Kelway has had varied experience of this, for the animals and birds which she has domesticated include dormice, shrews, hedge-hogs, long-tailed field-mice, a brown owl and a heron. Of these the most attractive seem to be dormice; they have such endearing ways, and show intelligence; they know a bad nut by its weight, as does a nut-hatch, soften hard cob-nuts in water, and have learned to suck the juice of sweet-briar.

The habits of hedge-hogs are fascinating. Everyone who watches animals or birds knows how each individual is a personality. Jimmy, a young hedge-hog, at the age of ten months, developed an Oedipus complex for his widowed mother, at which his two maiden sisters looked askance. His unbridled passions proved fatal to him. What happened to the problematical offspring of this incestuous union is, in the author's words, "beyond my knowing, but not beyond my understanding." Newly-born hedge-pigs are pathetically naked: under hedge-hog law marriages within the prohibited degrees apparently entail ruthless penalties. The Tale of Tereus—*mutatis mutandis*—is perhaps the solution.

Miss Kelway believes that hibernation is largely a question of food-supply: it is necessary in the wild, from lack of food. So long as she fed her hedge-hogs they remained quite active. Under natural conditions many do not survive the winter.

Shrews she found difficult to capture: their slim bodies escaped easily between the wires of box-traps (their slight weight does not spring a break-neck trap). They often die of fright, and so rapid is their digestion that they quickly die of hunger. A cross-country chase after a pair of shrews proved to her that their squeakings are often not the battle-cries of conflicting males, as has been stated, but pæans of love-making couples.

In her too modest foreword Miss Kelway says that we shall not find many new facts in this book. Nevertheless some readers will learn, perhaps for the first time, that, as the author discovered with deer, you forfeit the confidence of any wild creature if you meet its eyes, a fact well-known to bird-watchers. Some may feel sympathy with the injured heron who nearly succumbed to his first drink of whisky: others with the guests who objected to their bathroom ablutions being critically considered by a brown owl.

The author's photographs are exceptionally good. That of a pigmy shrew devouring a worm nearly as large as herself is remarkable: those of dormice asleep and awake are delightful. Altogether a most fascinating book.

E. W. HENDY

James Watt, Craftsman and Engineer. By H. W. DICKINSON. (Cambridge University Press, 10*s*. 6*d*.)

This comprehensive work begins with a very helpful description of the state of engineering at the time of Watt's birth, so that the reader is able to appreciate the extent and usefulness of the great inventor's genius. Next, after many interesting facts concerning the childhood of Watt, we learn of his ambition to become an instrument-maker. At the first opportunity, although but 19 years of age, he set out for London (the Mecca of the trade at that time) "with two guineas in his pocket and his father's blessing," spending twelve days in the saddle on the journey. The guilds in London made it difficult for an outsider to obtain a footing in any trade, but young Watt persevered and succeeded in making a start with one John Morgan, an instrument maker of Cornhill. Here Watt worked with such assiduity that he contrived to crowd four year's work into one, but at the price of great hardship and some damage to his health. The close of the year saw him on his way back to his native Scotland, proud in the realisation of his first ambition, that of being a skilled craftsman. After a rest to recuperate his health he became mathematical instrument maker to Glasgow University.

The turning point of his career came, apparently by chance, when he repaired a model of the Newcomen or atmospheric engine belonging to the University. The work was after his own heart and he followed it by making various experiments with steam engines, particularly with condensers. Then came the meeting with Boulton, the development of joint proposals and the long-awaited reward for perseverance.

The author describes with a wealth of detail the many difficulties encountered and overcome by Watt in his struggles to evolve an efficient steam engine, chief among them being his

indifferent health, the poor materials then available and the lack of funds. Some measure of his success appears to have been due to his lack of conceit and his readiness to form lasting friendships, for on many occasions he required encouragement. That he was fully aware of his shortcomings in the business world also is clearly shown in an extract from a letter written to a close friend in 1772: "I would rather face a loaded cannon," he declared, "than settle an account or make a bargain. . . .It is enough for an engineer to force nature and to bear the vexation of her getting the better of him."

There is much of interest and charm in the book which the reader must discover for himself. It will be sufficient here to state that the author has shown exceptional skill in selecting and arranging the large amount of relevant matter and in the more difficult task of interspersing suitable comment and explanation in exactly the correct proportion. The illustrations are very fine indeed.

The Story of Telford. By Sir Alexander Gibb, G.B.E., C.B. (MacLehose. 16*s*.)

The keynote of *The Story of Telford* is one of thoroughness, a quality itself typical of all Telford's works. In the Foreword Lord Macmillan states that "the author and his subject are united by ties which were formed in the early years of last century"; the existence of these bonds is apparent throughout the book, for the author has captured the atmosphere of Telford's personality and is able, also, to present his characteristics against the accurate background of his private life.

The book is, in every sense, a "story"—in the wealth of its material no less than in the appeal of the very human happenings which it chronicles. The spartan setting of Telford's boyhood in Eskdale, his apprenticeship as a mason further afield, and his decision, at the early age of twenty-four, to set out for London, are among the first of many delightful pictures of the engineer's life. The scene changes to London, then to Portsmouth, and the reader is shown how Telford grasped every opportunity that came his way, pulling himself up the ladder of his profession by sheer ability. The author quotes many letters written by Telford to his friend and chief correspondent, Andrew Little; all show his devotion to his work and many are coloured with a delightful sense of humour, as may be seen in the following extract: "Knowledge is my most ardent pursuit. . . .And I am determined to study with unwearied attention until I attain some general knowledge of Chemistry as it is of Universal use in the Arts as well as in Medicine. I wish Andw. that you saw me at the present instant surrounded by Books, Drawings—Compasses, Pencils and Pens, etc., etc., great is the confusion but it pleases my taste and *that's enough*."

Thus the author unfolds the panorama of Telford's progress. One commission led to another, his confidence more than keeping pace with responsibility, and although he was frequently involved in disputes his opinions were invariably proved correct. Surveys, Bridges, Canals, Roads, Harbours, and Reports to Authorities—all were executed with the same patient thoroughness and we may well wonder how one man could have found time to give attention to so many interests.

The book contains three maps and more than thirty illustrations; the outstanding works are classified in a comprehensive list. Indeed, it is evident that no effort has been spared to make the volume a complete account of a great life.

Flight To-day. By J. L. Nayler and E. Ower. (Oxford University Press. 3*s*. 6*d*.)

Unsaddled by tedious technicalities, this neat volume sums up almost every aspect of modern aviation. The book must be regarded as being for those whose knowledge of aviation is limited, and will best be appreciated by readers whose flights are mental rather than aeronautical.

The matter of the book is both interesting and informative, and several chapters whet the appetite. That on The Uses of Aircraft reveals some surprising aspects. To hire an Imperial Airways aerial ambulance at 1*s*. 6*d*. a mile seems very reasonable, and the transport of a cargo of queen bees must make any pilot nervous of crashing. The chapter on airships makes fascinating reading, and raises doubts whether the British policy of not having dirigibles is in the best Imperial interests.

The weather and the airways are both handled in a readable manner, and many an enquirer will be interested to learn the method of navigation through thick fog or out of sight of land.

I have two small bones to pick with the authors. First, I think the average pilot regards his wheel brakes as an assistance to ground taxying rather than as a means of arresting his run. Secondly, I cannot help thinking that the jar received on a parachute landing is much greater than the 4 foot drop suggested as a parallel. Many parachutists wear special ankle boots, but at least the authors can be complimented on refraining from saying that if the parachute does not open the wearer may apply for a new one free of charge.

Mr. Nayler, whose work is well known to readers of *Discovery*, and Mr. Ower have included really good photographic illustrations of engines and aircraft types. Not content with that they have set down diagrams which, most unusually, are exactly to the point. There is a welcome lack of digression, and the title justly describes the book.

B. J. Hurren

Tyrolean June. By Nina Murdoch. (Harrap. 8*s*. 6*d*.)

This is an excellent example of the modern travel-book, which records the author's subjective reactions to the country concerned, with the insertion, by way of variety, of an occasional local legend. Nina Murdoch has the faculty of keen observation; she is content to travel at leisure; and she does not object to betraying a rudimentary knowledge of the local language. The result is an attractive picture of Innsbruck and its neighbourhood, which should make the reader keen to visit or revisit this charming land. The non-mountaineer will rejoice to find the mountains treated as splendid features of the landscape, not as climbs of varying difficulty.

At the same time, *Tyrolean June* has fallen into that sentimental attitude which seems inseparable from recent English books about Austria. Frequent digs at Italy concerning the South Tyrol may be fashionable, but are they appropriate in a topographical work? And is the lot of the Alto Adige peasants really a harder one to-day than it has been? Emigration from the Val Gardena to the Zillertal certainly took place in 1919, but, as the author herself tells us, it is not so long since Zillertalers were forced to seek asylum in Prussian Silesia. Argument on such subjects is endless and we should have preferred the question left untouched in a volume otherwise so congenial. Dr. Adalbert Defner's beautiful photographs illustrate the country at all seasons, not only in June.

Ships. By HENDRIK WILHELM VAN LOON. (Harrap. 10s. 6d.)

Mr. Van Loon has set himself with his accustomed vigour to knock the bottom out of the idea that there is any relationship between seafaring and romance. "Man," he says, "is a predatory animal who lives by eating other animals and who enriches himself by taking that which belongs to his neighbours," and it is this instinct, he maintains, which lay behind the construction of the earliest craft and the great voyages of exploration. The incentive of genuine curiosity he puts at no more than five per cent. Moveover, sailors have always been treated as animals or slaves.

All this is brought out and rubbed in as we follow Mr. Van Loon down through the ages, the while he traces neatly for us the evolution of the modern steamship from the earliest dug-out canoe. But his insistence on his case detracts somewhat from our pleasure, and at any rate he spoils his argument by a certain exaggeration. For though nobody will deny that the sailor's life was anything but comfortable, the author overlooks the fact that life ashore was for the working classes almost as nasty, brutish and short, down to comparatively recent times, and that even the well-to-do were not always particularly fond of cleanliness and sanitation.

However, it is good to find the old and still taught story that Fulton was the father of the steamboat, blown to bits in favour of the cruelly forgotten John Fitch. Steam did not kill the sailing ship. It was the Suez Canal that signed the death warrant, and now while the last of the great sailing ships have dwindled nearly to nothing, the days of the steamers are numbered too; they are doomed to be swept out of business by the aeroplane.

Mr. Van Loon is a cynic, but he is entertaining, and his own special type of illustration is here in force. Also, readers (with predatory instincts?) will discover a Van Loon map of the World hidden in the folded wrapper.

The Great Trek. By MAX MILLER. (Lovat Dickson. 7s. 6d.)

The famous drive of 3,000 half-wild reindeer across 2,500 miles of frozen wilderness north of the Artic Circle, from Kotzebue, Alaska, to Kittigazuit, Canada, was an epic feat. As the projected eight months lengthened into five years, and unforeseen difficulties were encountered and overcome, the story gained more and more in heroism. As an outcome of such a struggle *The Great Trek* is disappointing.

The story is presented in a disconnected fashion; or rather, is not presented at all, but consists of isolated happenings set down in more or less chronological order. How much this was beyond the control of the author cannot be told, as the reader is not informed what connection, if any, Mr. Miller had with the drive, or what his sources of information were. After reading the whole, a connected picture of the drive cannot be made. But, perhaps, this is intended; perhaps it represents the atmosphere of the Arctic, where "to-morrow is also a year," and the evils of the day suffice without dwelling upon those of the past or future. Certain it is that Andrew Bahr, the veteran Lapp chief herder, after five years on the snow and ice, must have found it difficult to connect the start from Kotzebue, in 1929, with the arrival in 1934. Only ten per cent. of the herd were original stock; the rest had been born en route. Only one of the Eskimo herders had come right through. Certain it is, also, that Peter Wood, whose very Eskimo story of the drive is printed verbatim, remembered the time Bahr ate bad oranges and nearly died more vividly than he did any items concerning dates and distances.

For all its shortcomings the book is worth reading; it is intriguing to wander among the maze of incongruous proper names, such as Terence Elooktoonah, and difficult place names, such as Saganavirktok, even if the *dramatis personæ* do get mixed and the *mise-en-scène* is often a matter of conjecture. It is a pity, however, that the photographs were not more worthy of their lavish treatment, and that in one particular instance the shadow of a dog should have been thrown in one direction and that of his master in the opposite quarter!

Through the Telescope. By E. A. FATH. (McGraw-Hill. 10s. 6d.)

In this book the author's somewhat novel plan is to take the reader, in imagination, into two of the great observatories of the United States. Beginning with a visit to the Lick Observatory, he is introduced to the various members of the solar system, as revealed in detail by the famous 36-inch refractor. Later on he travels, by aeroplane, the comparatively short distance to Mount Wilson, where the great 100-inch reflector, at present the world's largest telescope, carries him out to the stars and widens his range of vision until he reaches the most distant parts of the universe so far within optical reach. For some of this survey the eye at the telescope is insufficient: the aid of the photographic plate and the spectrograph has to be called in, and this gives the author an opportunity of describing in simple language the technique actually employed in the use of these indispensable adjuncts to the telescope.

But there are still some gaps to fill in before the picture can be considered reasonably complete, and for this purpose the reader is conveniently taken into the observatory library.

As may be imagined, this practical method of treating the subject has resulted in the production of a very readable book. The whole forms quite a useful connected story, though, like some similar works published in this country in recent years, it does little more than pick out the highlights of astronomy. Such books cannot and do not give a real grounding in the subject, though they may lead the reader to the purchase of a good text-book.

Professor Fath's book is beautifully illustrated and quite up-to-date. Errors and misprints are few; in fact we detected only three in the whole book.

Astronomy. By ROBERT H. BAKER. (Macmillan. 16s.)

This is the second edition of a work which was designed as "A Textbook for University and College Students" in the United States, and we should imagine that it was admirably adapted to fulfil that function At any rate, if Astronomy were a school subject in this country (which, unfortunately, it is not) we should certainly recommend just such a book for an introductory course, though the treatment is not sufficiently advanced for University use on this side of the Atlantic.

The book is divided into twelve chapters, which cover the whole field of descriptive astronomy in a very satisfactory way, and the almost complete absence of mathematics will make it attractive to the general reader who possesses the bare minimum of scientific knowledge

There is a useful bibliography at the end of each chapter, and the illustrations are excellent. Every amateur astronomer should possess a copy of this very useful book.

The Eskimos. By KAJ BIRKET-SMITH. (Methuen. 15s.)

The Eskimos hold one of the more important strategic points in the study of the distribution of man and the development of his culture. Bering Strait and Alaska, the home of the Western Eskimos, are the gateway by which early man most probably entered America; while the severity of climatic conditions in the Arctic area affords a salient demonstration of the influence of environment by laying down, more or less rigidly, the only lines along which cultural development there can take place. As these climatic conditions closely correspond with those which prevailed over the greater part of western and north Central Europe at the close of the quaternary geological epoch, it is not surprising that archæologists have sought in the material culture of the Eskimos for parallels to interpret relics of the later phases of the European Old Stone Age. The theory of a direct relation between palæolithic and Eskimo culture, which for some time has been somewhat in abeyance, is revived by Dr. Birket-Smith in a modified and more acceptable form.

Although the importance of the place of the Eskimos in anthropological studies has long been recognised, it is only comparatively recently that intensive investigations by anthropologists from Canada and the United States have been applied to the ethnological and archæological problem in the west. As a result, more particularly of archæological investigation in Alaska, a succession of at least three early cultures has been determined, in which it is highly significant that the oldest is characterised by a remarkable artistic development, manifested in ivory carving. The relation of the early cultures to that of the modern Eskimo is still obscure and must remain *sub judice* pending further investigation; but in the meantime Dr. Birket-Smith puts forward tentatively a theory which differs in certain respects from that now generally current in America.

The Eskimos occupy a territory of some six thousand miles in extent, lying along the northern fringe of the American continent from Labrador and Greenland to Bering Strait. They number in all about 40,000. Their culture is basically homogeneous, and, except in one group, is uniformly dependent on the sea and the seal. There are, nevertheless, localised differentiations, of which it will be found the author has taken full account in this detailed description of the Eskimos, which is the outcome of prolonged and intimate acquaintance. From these differentiations in culture, anthropologists have drawn certain deductions as to Eskimo origins and migrations. The view that is here put forward is that the distinctive Eskimo culture developed in the Hudson Bay area, while certain peculiar and destructive characteristics of the Western Eskimos are an outcome of the result of their migration to, and contact with the indigenous inhabitants of the Alaskan and Bering Straits area.

Whatever may be the effect of further investigation on the ultimate acceptance of Dr. Birket-Smith's views on Eskimo origins, they cannot detract from the merits of what is perhaps the best, and is certainly the most readable, detailed account of a very interesting people.

E. N. FALLAIZE

Salamina. By ROCKWELL KENT. (Faber & Faber. 15s.)

So used have we become to the austerity of writings dealing with the Far North, that a book on the subject which adopts a warmer-blooded attitude must needs command interest. This *Salamina* does, whatever its defects; and it has the great and outstanding merit of making the Eskimos live. Here they are human beings, not simply objects of anthropological interest. To one reviewer's mind the defect of the book is psychological: there is a tendency towards sentimentality. But this is doubtless a reaction from the usual unrelenting grimness and, in fact, detracts but little from the entertainment provided, though it may be responsible for a false valuation here and there.

Taken as an episodic romance, *Salamina* is charming; it makes no pretence of academic accuracy as a geographical or anthropological study. The drawings by the author are as striking as his descriptions and some of the little vignettes are really admirable. Like a great deal of the publisher's recent work, the production of the volume is first class.

A History of English Brickwork. By NATHANIEL LLOYD, with an introduction by Sir EDWIN LUTYENS. New and abridged edition by LESLIE MANSFIELD. (H. G. Montgomery. 12s. 6d.)

The Tylers and Bricklayers Company has sponsored this admirable re-publication of Lloyd's work. It is enriched with no less than 140 large plates which completely illustrate every point in the text and provide even for the most complete amateur as good a synopsis of English brickwork in domestic and ecclesiastical architecture as could be desired.

In the text the history of the development of the craft and of its gradual improvement is carefully told. Virtually all English brickcraft originated by the reutilisation of Roman bricks in mediæval buildings. The best example of this is seen in St. Alban's Cathedral, where the looted site of Verulamium provided unlimited material for the builders. Earlier examples of reusage of bricks by Saxon builders are numerous, but they merely used them for partial and irregular bonding of Saxon rubble walls. There seem to have been no actual Saxon bricks. The first use of English bricks was in the 13th century, when locally made bricks, following Flemish proportions and nature, were used in the building of Little Wenham Hall, in Suffolk, the oldest brick dwelling in England. This, the first, remains also one of the loveliest of all brick buildings. It is a fortified mansion, with tower, castellation, and Gothic windows, exceedingly well preserved. Caister Castle, the reputed ransom-price of Sir John Fastolf's victim, the Duc d'Alençon, is another type of building, grandiose and impressive, to be grouped with masterpieces of brickwork like Hurstmonceux.

Towards the end of the 15th century the more ornate type of building appears, still preserving the grandiose manner. Oxburgh Hall (1482) shows the transition to that full and splendid Renaissance, of which Layer Marney, in Essex (1520), is the finest example. In no country can brickwork reach a higher standard than in England in Tudor times.

The author of this book discusses all the technical problems of brickwork and the methods of cutting or moulding ornamental devices in brick. The tools of the craft and all ancient documents illustrating its growth are dealt with in full.

As illustrated in this finely produced work, English brickwork has rarely been under any alien influence except that of Holland. It is astonishing, in view of the various influences that came in from the east into architecture in stone in the Middle Ages, to see how little effect the superb brickwork of Persia and Byzantium had on Anglo-Saxon architects. In the 12th and 14th centuries every conceivable experiment in bonding and diaper of bricks was practised in the Near East. And yet not the faintest reflection of what was going on there reached England.

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